New England Integrated Sciences & Assessments: Air Quality, Climate Variability, and Human Health

Cameron Wake
Institute for the Study of
Earth,Oceans, and Space

Tom Kelly
Office of Sustainability

University of New Hampshire

NOAA Office of Global Programs
October 17, 2005

New England
Integrated Sciences & Assessment

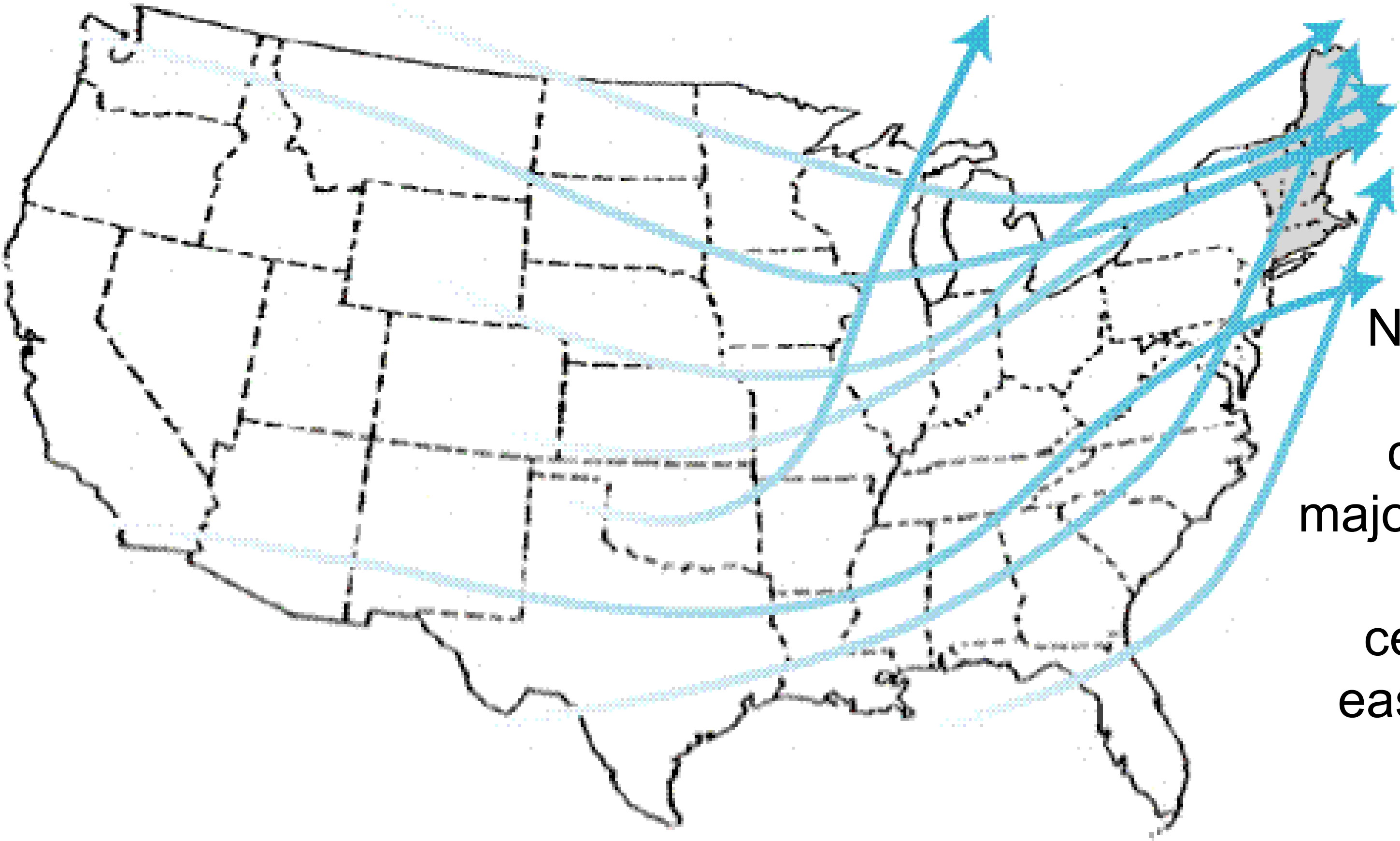
New England Integrated Sciences & Assessments: Presentation Overview

1. Background
   - -Why New England?
   - -Why air quality, climate, and human health?
   - -What is air quality?
   - -Why UNH?

2. NEISA Stories
   - -Fall rise in demand for hospital services
   - -New avenues for air quality forecasts
   - -Climate/air quality links
   - -Illness cost of air pollution
   - -Summer of 2004 pulmonary function study

3. Next Steps

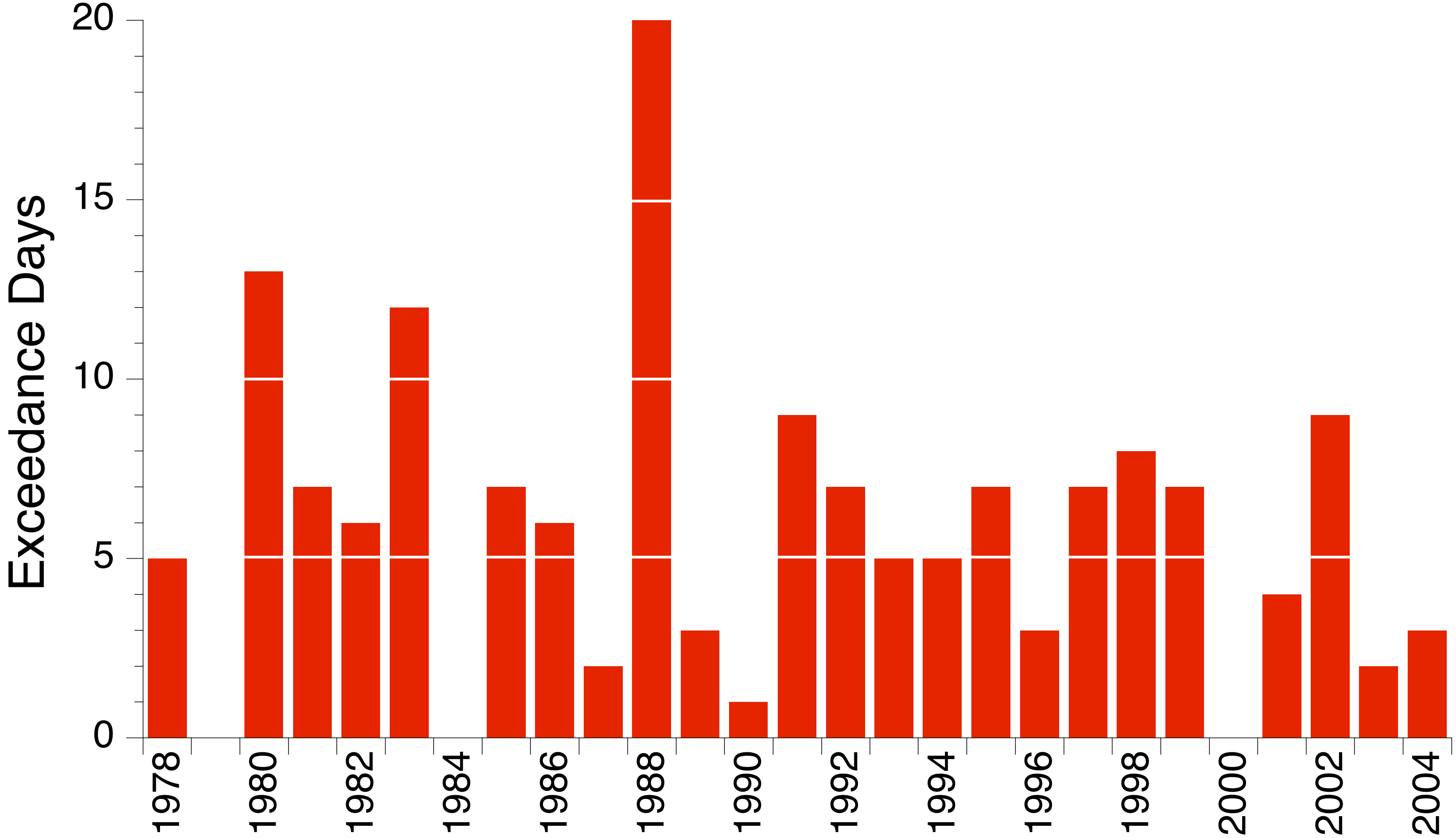
Map of Common Storm Tracks across the US



New England lies directly downwind of major urban and industrial centers in the eastern United States

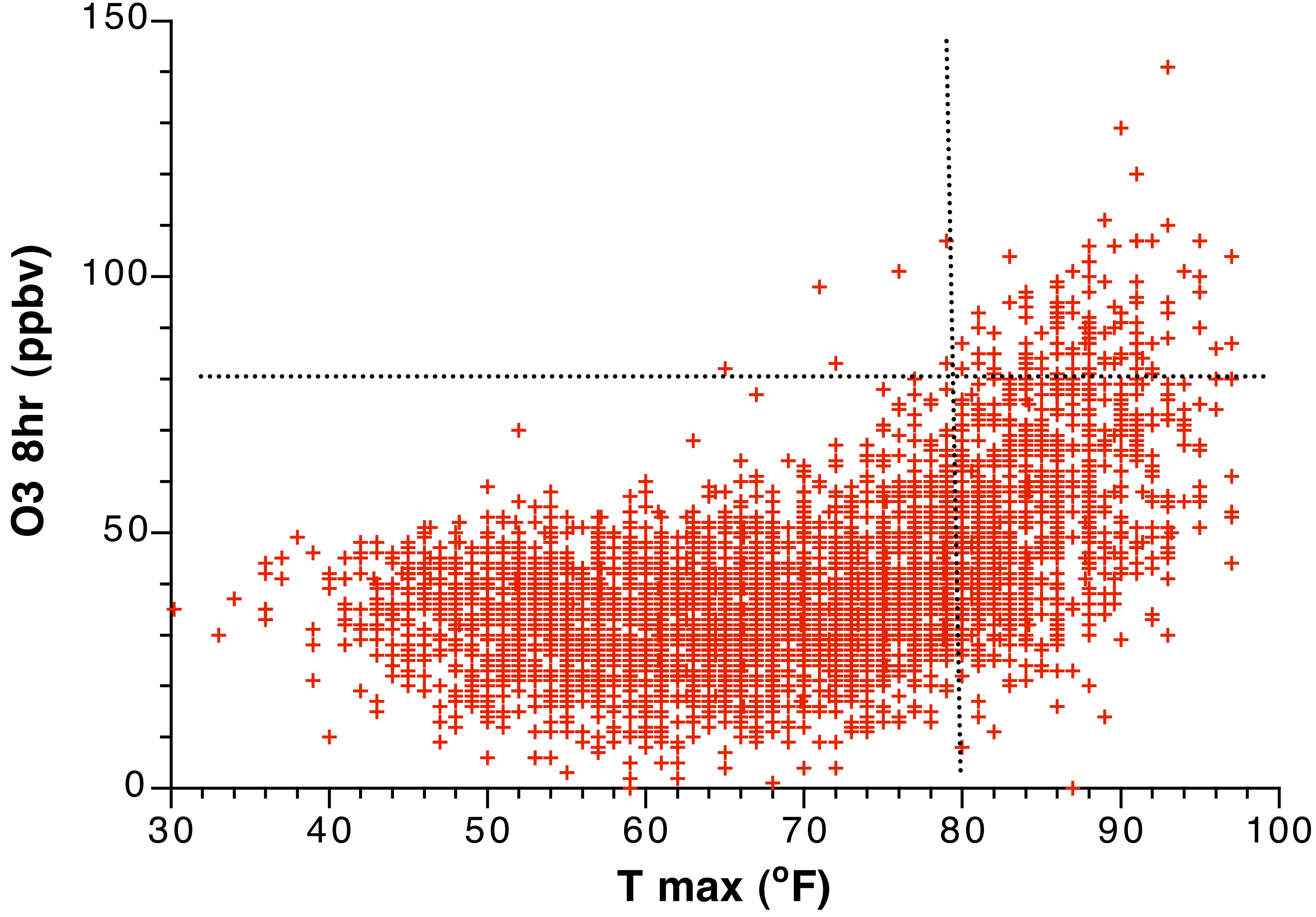
New England Integrated Sciences & Assessment

Portsmouth, NH Ozone Exceedance Days
(8 hr ozone > 80 ppb)



New England
Integrated Sciences & Assessment

Portsmouth 8 hr Ozone vs Tmax 1982-2002



New England
Integrated Sciences & Assessment

Adult Asthma Prevalence, 2000

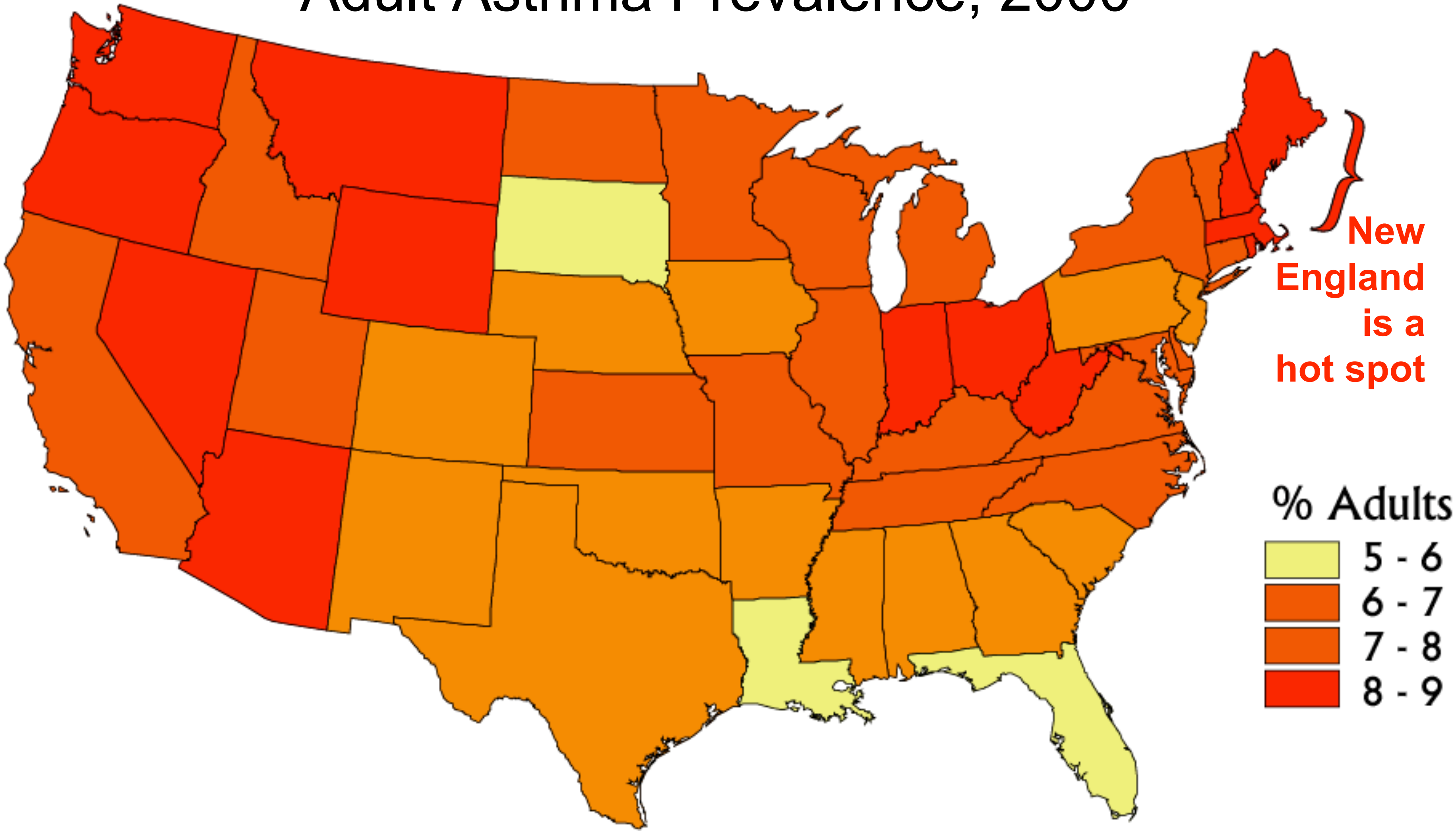


Figure illustrates percent answering Yes to "Have you ever been told by a doctor that you have asthma?" and "Do you still have Asthma?"
Source: Behavioral Risk Factor Surveillance System, 2000

Fastest growing chronic disease in US: >17 million (5 million children)

AIRMAP

MAPPING NEW ENGLAND'S CHANGING CLIMATE AND AIR QUALITY

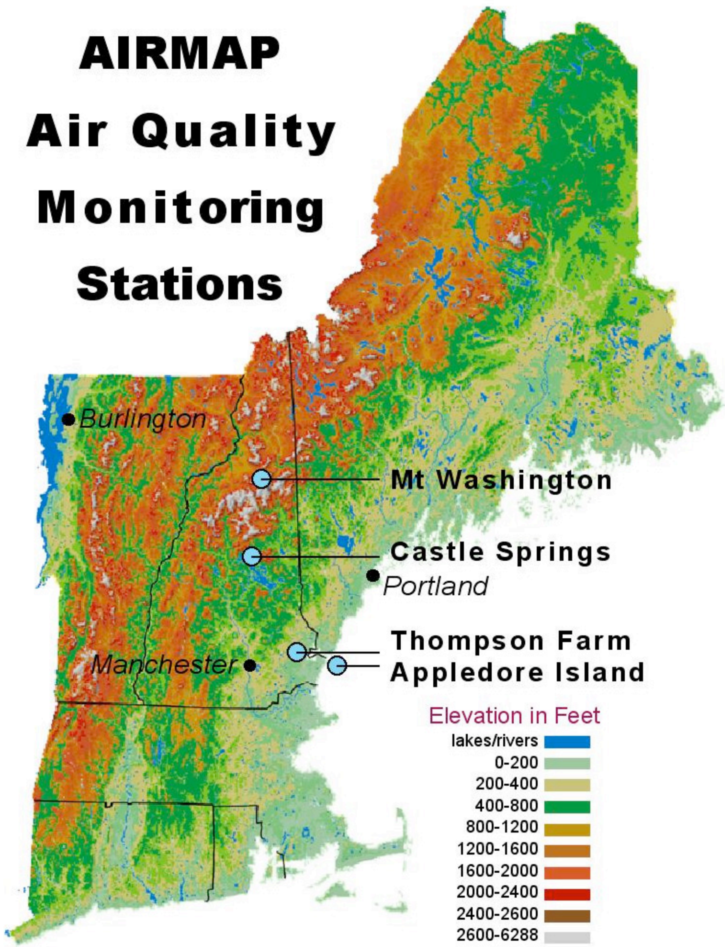
Project Summary: A UNH led air quality and climate program unraveling fundamental chemistry-climate connections in the rural atmosphere of New England that is situated directly downwind of major urban/industrialized emissions.

Our observations and research products provide a crucial foundation for improved forecasts of air quality, weather, and climate - critical needs of humankind.

Research Goals:

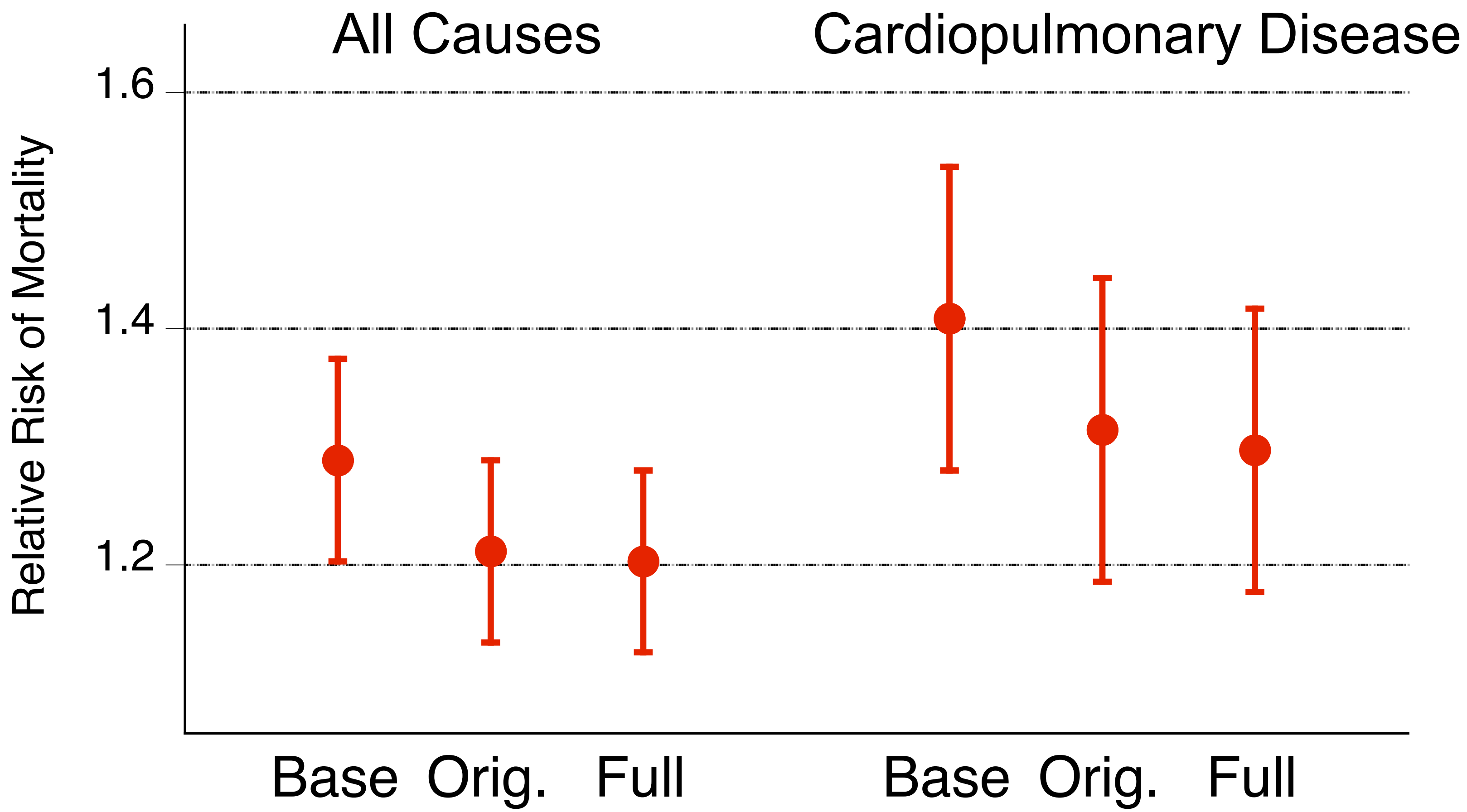
- Document and analyze trends in the regional air quality of New England that is affected by transport from upwind regions of the U.S. and Canada in conjunction with local emission sources.
- Delineate regional climate and air quality connections in the Northeast, especially those related to the biosphere.
- Quantify the relationship of regional air quality in the Northeast to intercontinental transport of North American outflow over the Atlantic.

AIRMAP Air Quality Monitoring Sites



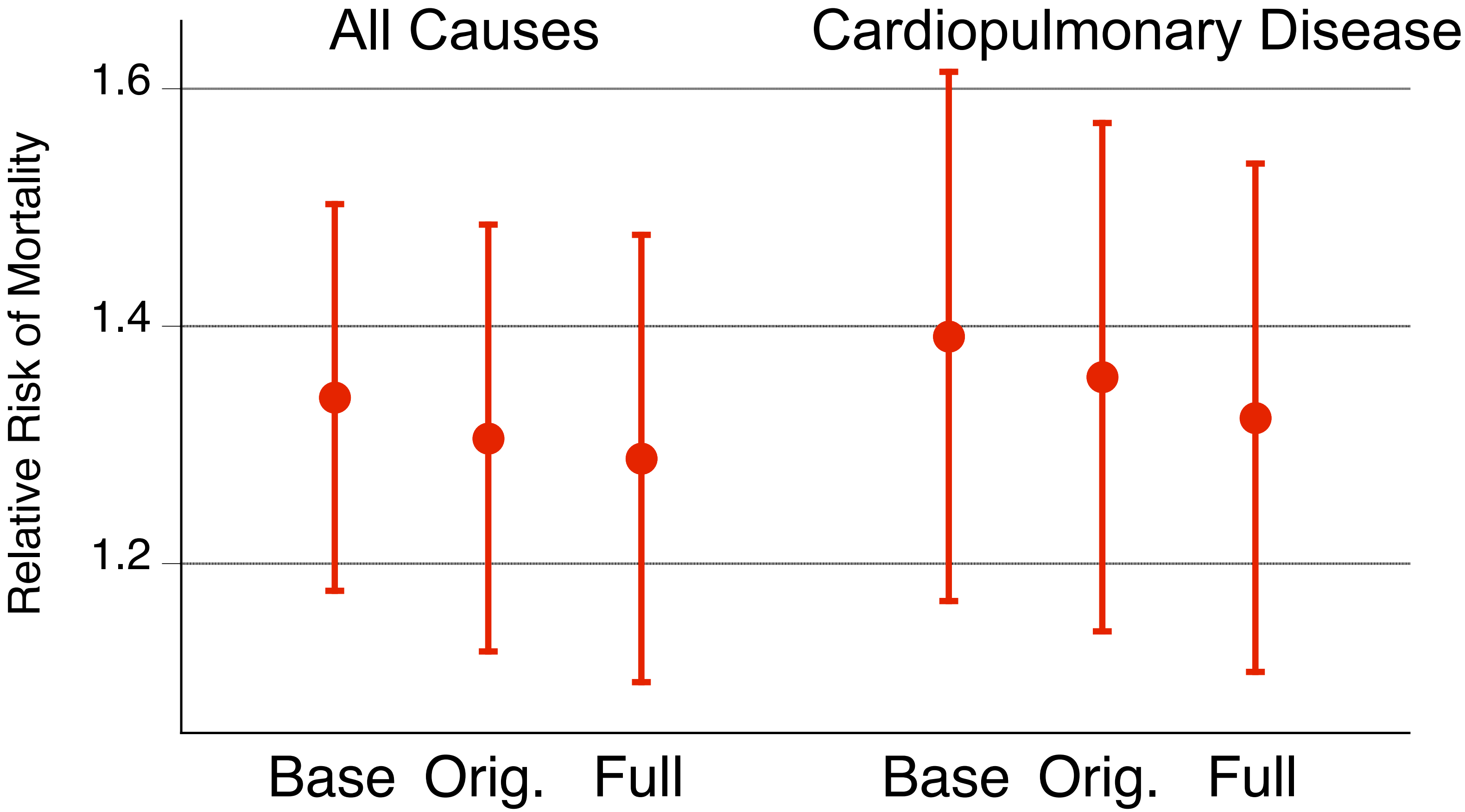
UNIVERSITY of NEW HAMPSHIRE AIRMAP NOAA

Fine Particles and Mortality: Reanalysis of the ACS Study



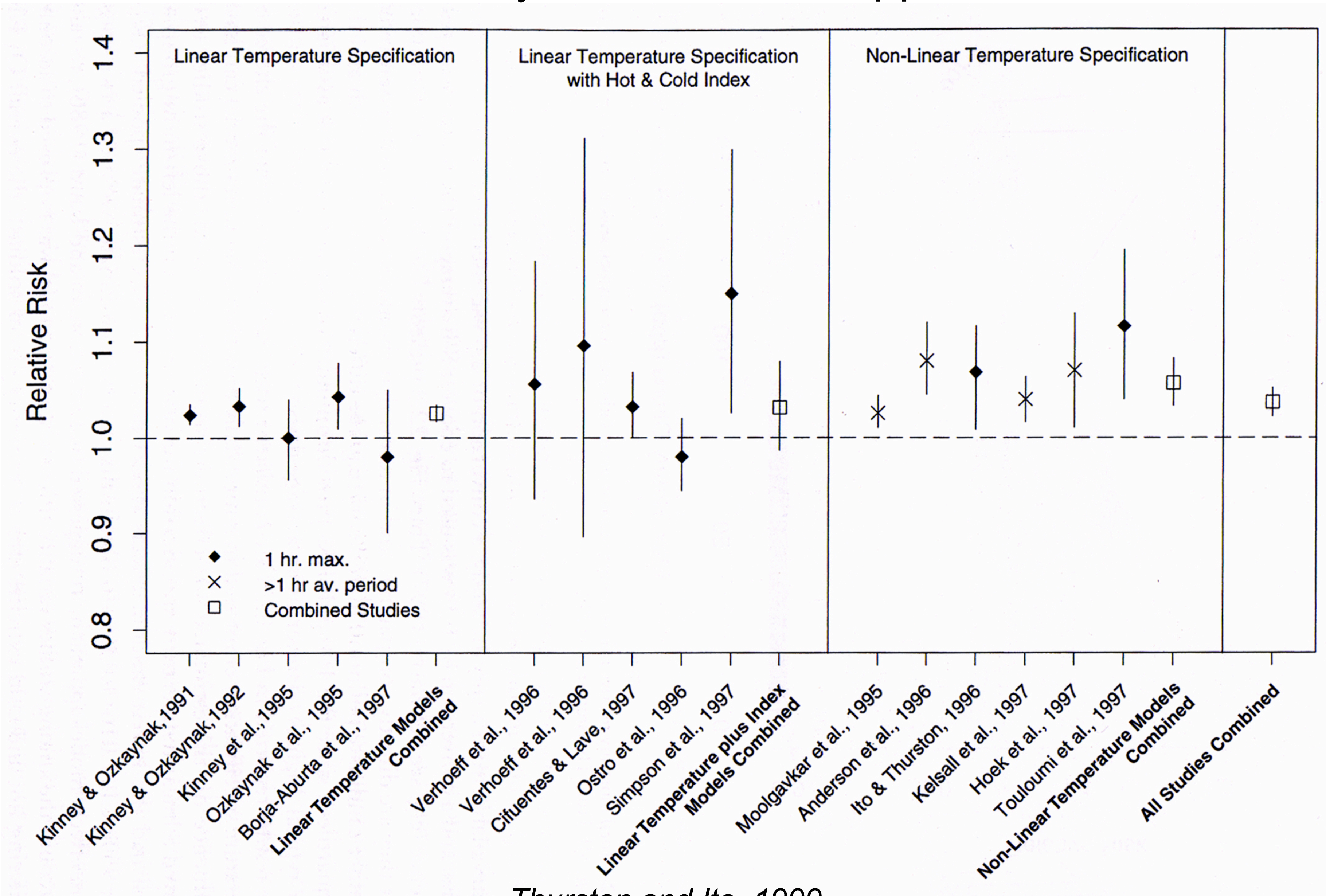
Risk Models associated with a 24.5 µg/m3 increase in fine particles
Base: air pollution only
Original: air pollution, sex, age, smokers, pack-years smoking, BMI, education
Full: Original plus several other covariates (passive smoking, marital status, alcohol, etc.)
Pope et al., 1995, A. Am J Respir Crit Care Med 151, 669-674
Krewski et al., 2000, Health Effects Institute, Cambridge, July.

Fine Particles and Mortality: Reanalysis of the Six City Study



Risk Models associated with an 18.6 µg/m3 increase in fine particles
Base: air pollution only
Original: air pollution, sex, age, smokers, pack-years smoking, BMI, education
Full: Original plus several other covariates (passive smoking, marital status, alcohol, etc.)
Dockery et al., 1993, N Engl. J. Med. Vol. 329, 1753-1759.
Krewski et al., 2000, Health Effects Institute, Cambridge, July.

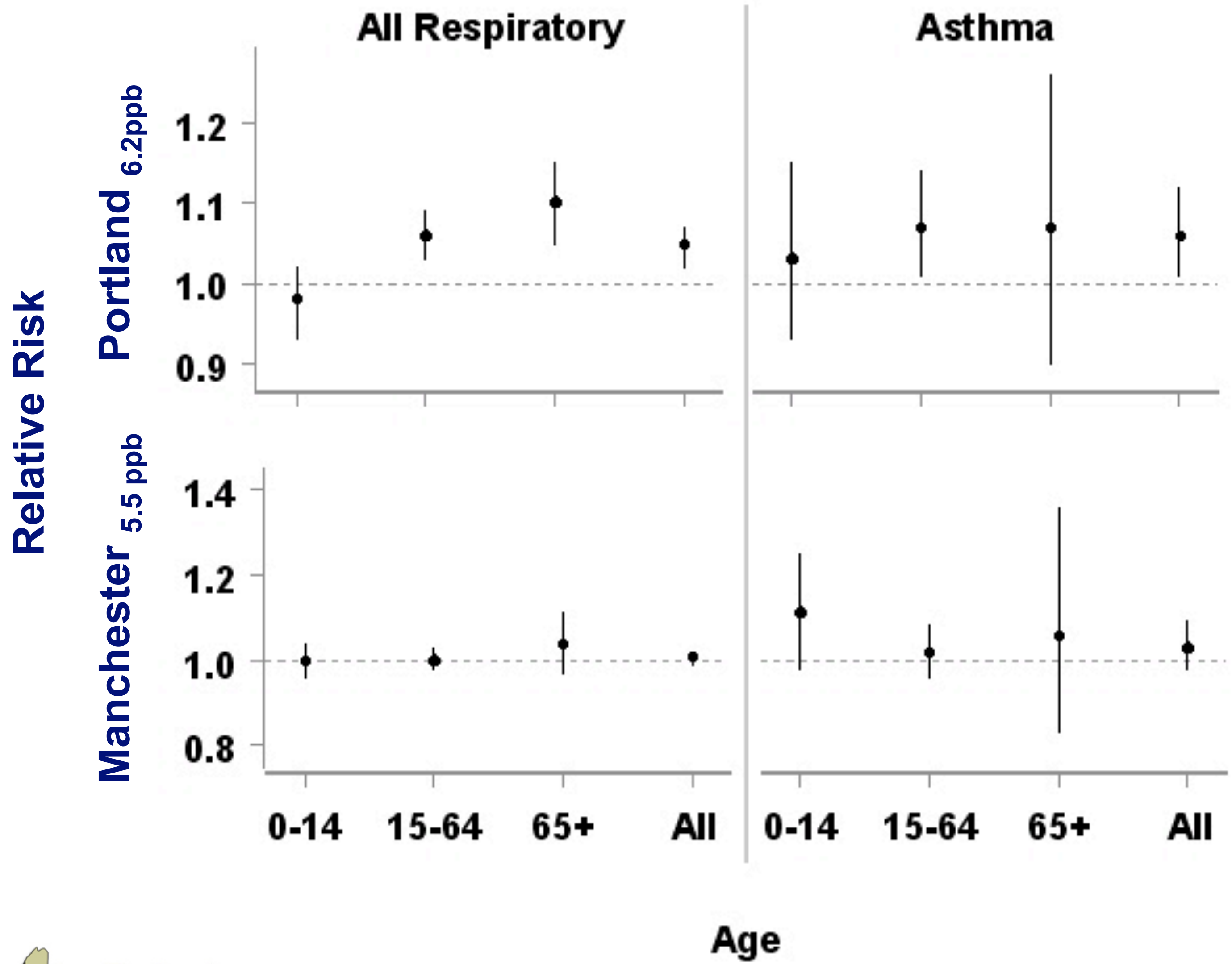
Relative Risk of Mortality with a 1-hr 100 ppb Ozone Increase



Thurston and Ito, 1999

Relative Risk of Hospital Admissions Due to SO_2

1 Day Average increased Interquartile Range



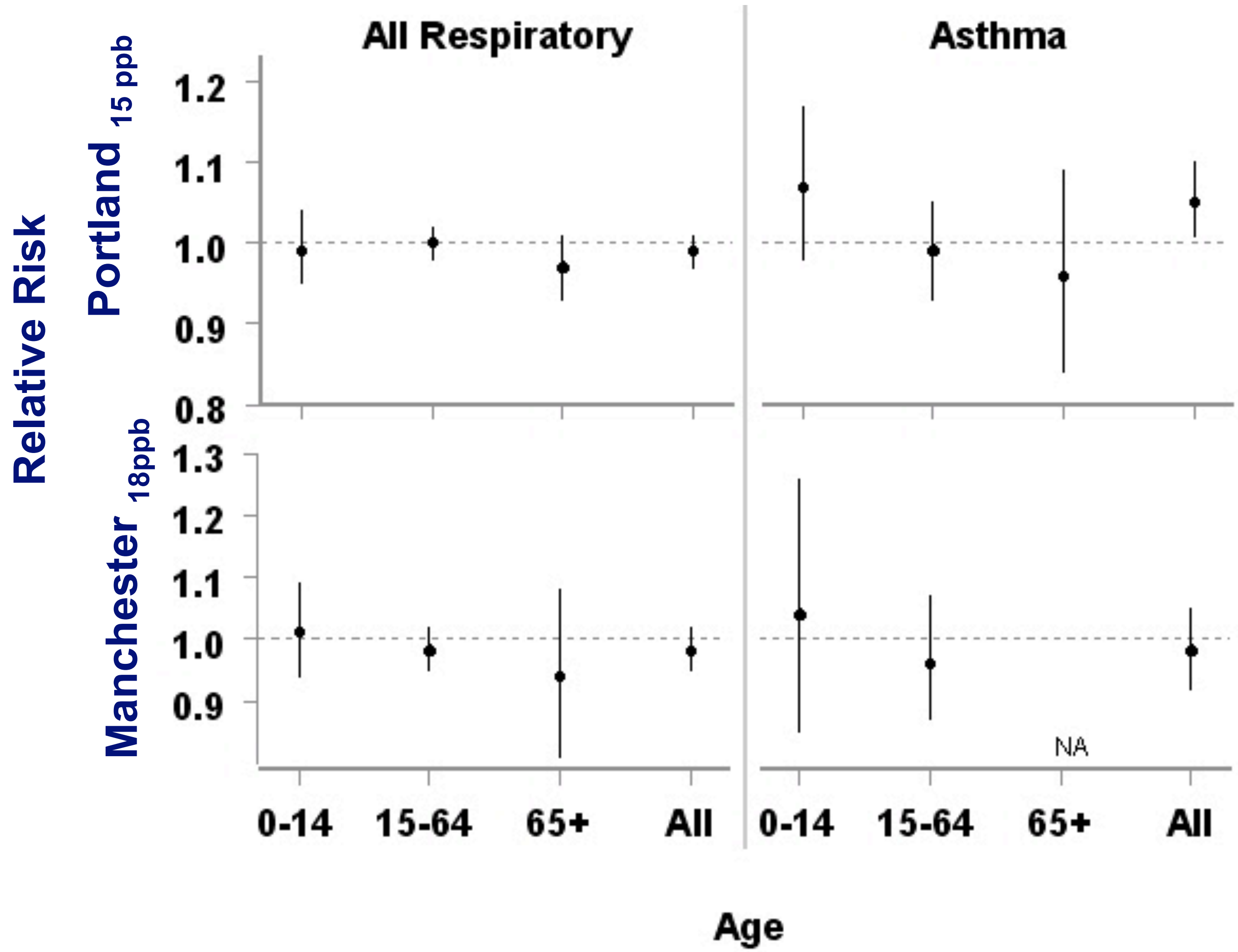
Effects range from 5-10% increases in Portland

Unclear in Manchester

New England Integrated Sciences & Assessment

Wilson et al., 2005 Environmental Research 97

Relative Risk of Hospital Admissions Due to Ozone
Maximum 8-hour Average increased Interquartile Range



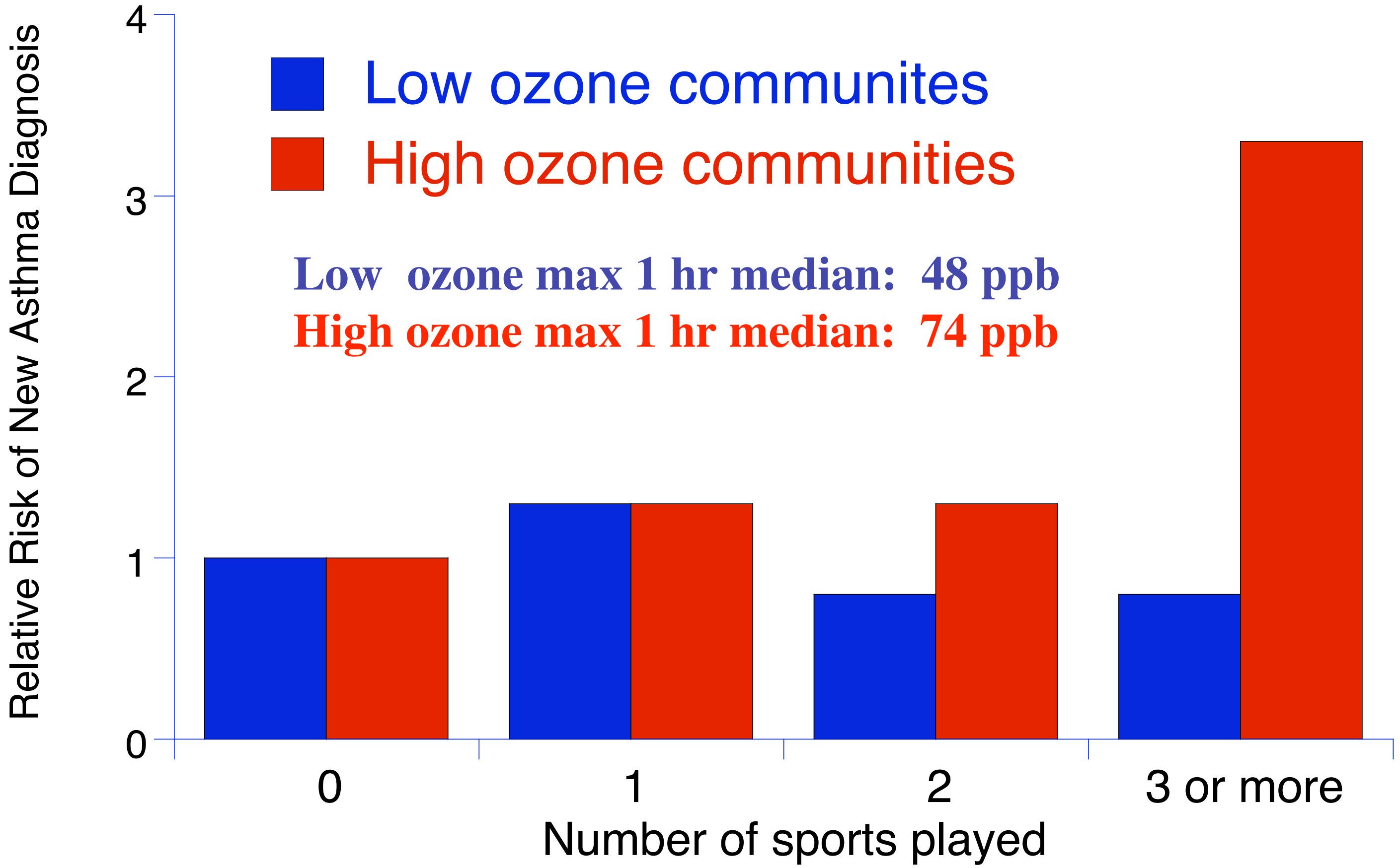
5% increase in Portland Asthma Visits

Unclear in Manchester

New England Integrated Sciences & Assessment

Wilson et al., 2005 Environmental Research 97

Asthma in exercising children exposed to ozone in California
3535 children - 12 communities - 5 years



McConnell et al., 2002, THE LANCET vol. 359

ORIGINAL CONTRIBUTION

Impact of Changes in Transporta and Commuting Behaviors During the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma

Michael S. Friedman, MD

Kenneth E. Powell, MD, MPH

Lori Hutwagner, MS

LeRoy M. Graham, MD

W. Gerald Teague, MD

Context Vehicle exhaust is a major source of ozone and other air pollutants. Although high ground-level ozone pollution is associated with transient increases in asthma morbidity, the impact of citywide transportation changes on air quality and childhood asthma has not been studied. The alternative transportation strategy implemented during the 1996 Summer Olympic Games in Atlanta, Ga, provided such an opportunity.

Objective To describe traffic changes in Atlanta, Ga, during the 1996 Summer Olympic Games and concomitant changes in air quality and childhood asthma events.

Design Ecological study comparing the 17 days of the Olympic Games (July 19–August 4, 1996) to a baseline period consisting of the 4 weeks before and 4 weeks after the Olympic Games.

Setting and Subjects Children aged 1 to 16 years who resided in the 5 central counties of metropolitan Atlanta and whose data were captured in 1 of 4 databases.

Main Outcome Measures Citywide acute care visits and hospitalizations for asthma (asthma events) and nonasthma events, concentrations of major air pollutants, meteorological variables, and traffic counts.

Results During the Olympic Games, the number of asthma acute care events decreased 41.6% (4.23 vs 2.47 daily events) in the Georgia Medicaid claims file, 44.1% (1.36 vs 0.76 daily events) in a health maintenance organization database, 11.1% (4.77 vs 4.24 daily events) in 2 pediatric emergency departments, and 19.1% (2.04 vs 1.65 daily hospitalizations) in the Georgia Hospital Discharge Database. The number of nonasthma acute care events in the 4 databases changed −3.1%, +1.3%, −2.1%, and +1.0%, respectively. In multivariate regression analysis, only the reduction in asthma events recorded in the Medicaid database was significant (relative risk, 0.48; 95% confidence interval, 0.44-0.86). Peak daily ozone concentrations decreased 27.9%, from 81.3 ppb during the baseline period to 58.6 ppb during the Olympic Games ($P < .001$). Peak weekday morning traffic counts dropped 22.5% ($P < .001$). Traffic counts were significantly correlated with that day's peak ozone concentration (average $r = 0.36$ for all 4 roads examined). Meteorological conditions during the Olympic Games did not differ substantially from the baseline period.

Conclusions Efforts to reduce downtown traffic congestion in Atlanta during the Olympic Games resulted in decreased traffic density, especially during the critical morning period. This was associated with a prolonged reduction in ozone pollution and significantly lower rates of childhood asthma events. These data provide support for efforts to reduce air pollution and improve health via reductions in motor vehicle traffic.

JAMA. 2001;285:897-905 www.jama.com

Despite advances in asthma therapy, asthma remains a substantial public health problem. In the United States, asthma is a leading cause of childhood morbidity, with an estimated prevalence of 6.9% in children and youth younger than 18 years.[1] Numerous studies have documented a rise in the morbidity, mortality, and prevalence of asthma in different populations.[2-8] The cause or causes of this trend remain controversial.[9-11]

Experimental, laboratory, and epidemiologic studies in the last several years have linked high concentrations of known air pollutants to respiratory health problems, most notably exacerbations of asthma.[12-23] However, opportunities to study the health effects of anthropogenic improvements in air quality are rare. One study found a decrease in particulate pollution and respiratory hospital admissions associated with the closure of an industrial factory in that community.[24] To our knowledge, no study has examined the impact of improved ozone pollution for an extended period of time on asthma exacerbations or other markers of asthma morbidity. Also, the extent to which moderate concentrations of ozone (ie, daily peak of 50-100 ppb) during various exposure lengths affects asthma morbidity remains controversial.[12-16]

Author Affiliations are listed at the end of this article.
Corresponding Author and Reprints: Michael S. Friedman, MD, Air Pollution and Respiratory Health Branch, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA 30333 (e-mail: mff7@cdc.gov).

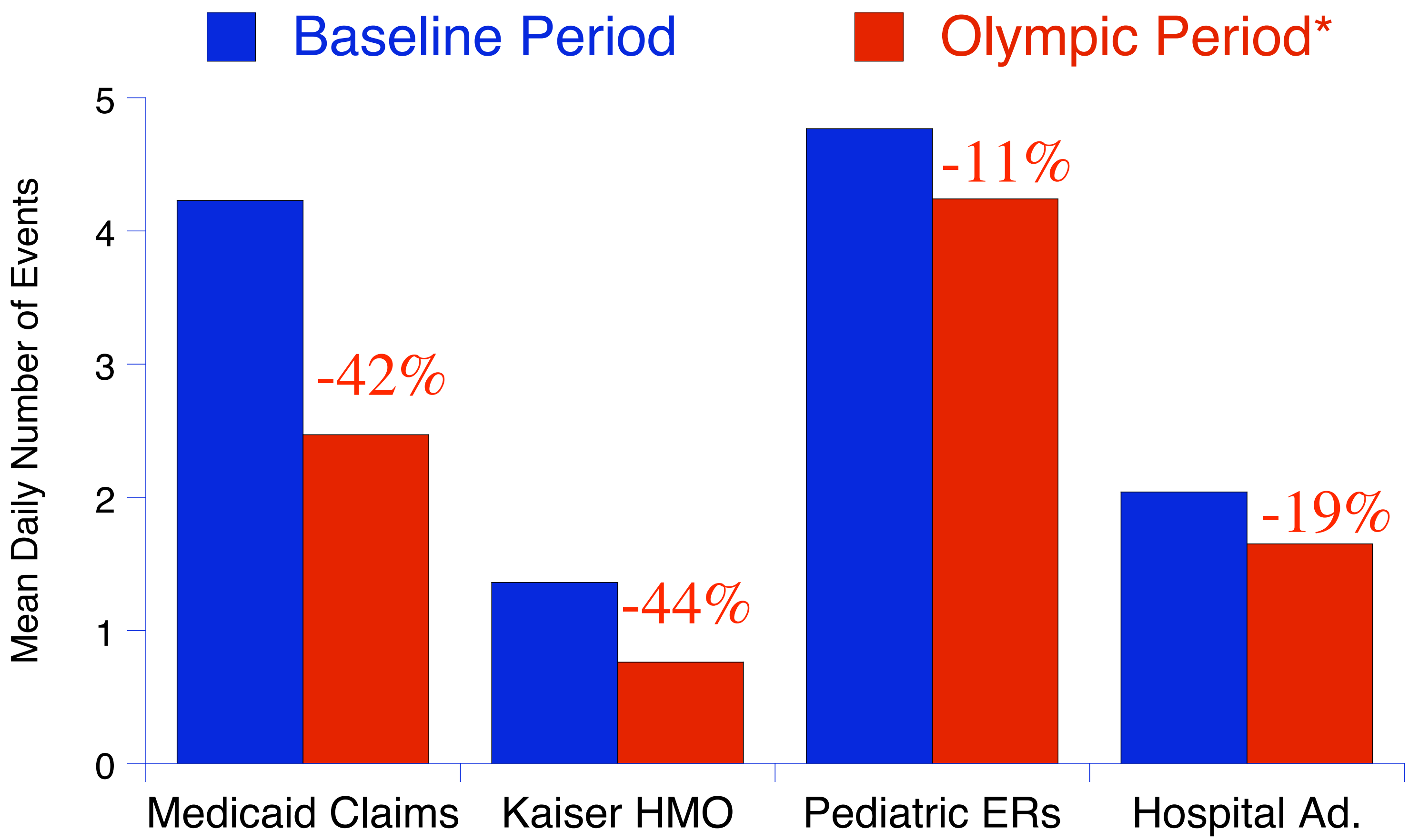
Public Transportation **+ 216%**

Traffic Counts **- 23%**

Ozone **-30%**

PM10 **-16%**

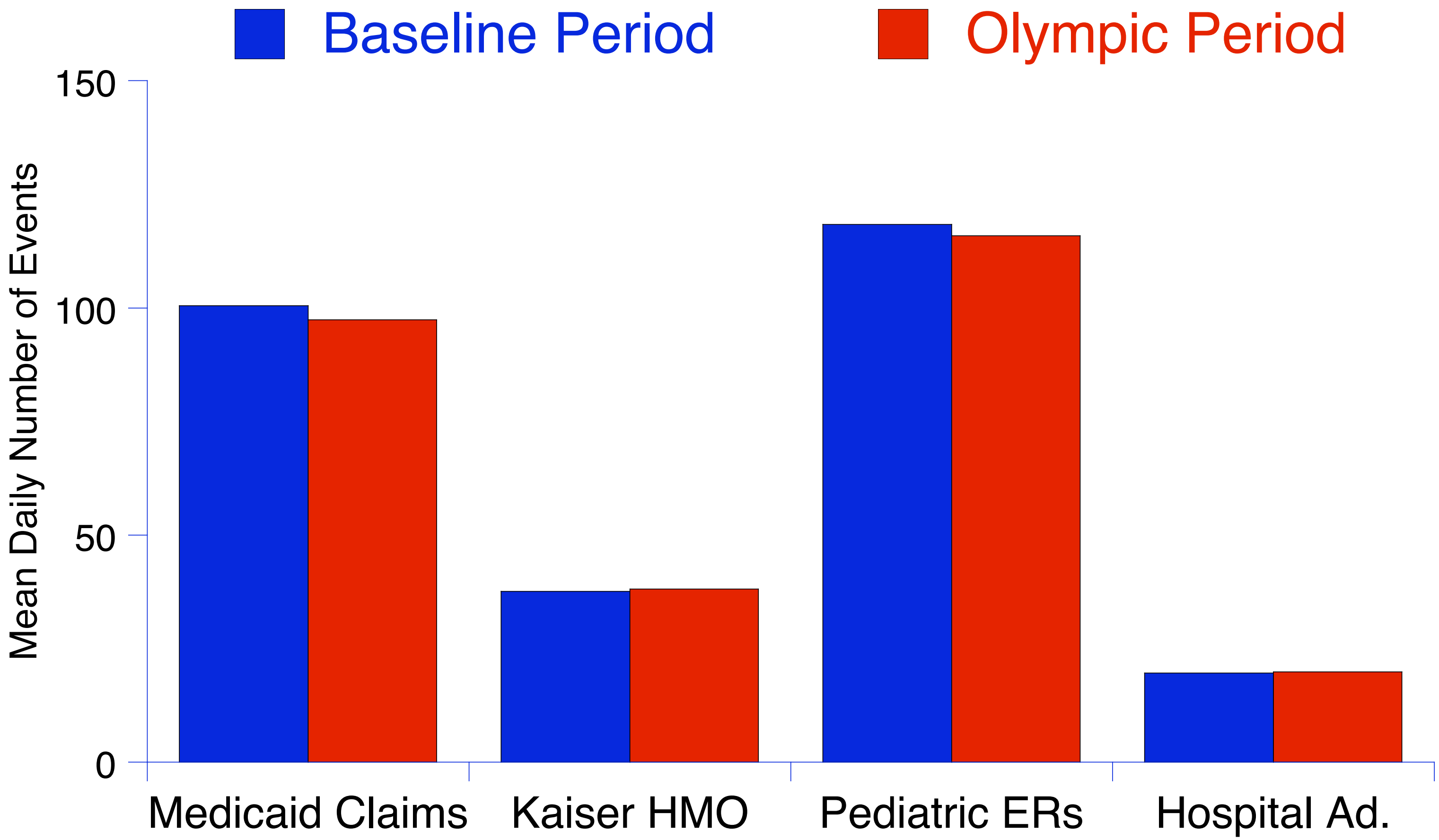
Results: Acute Care Visits for Asthma 1-16 year old residents of Atlanta



***July 19 – August 4, 1996**

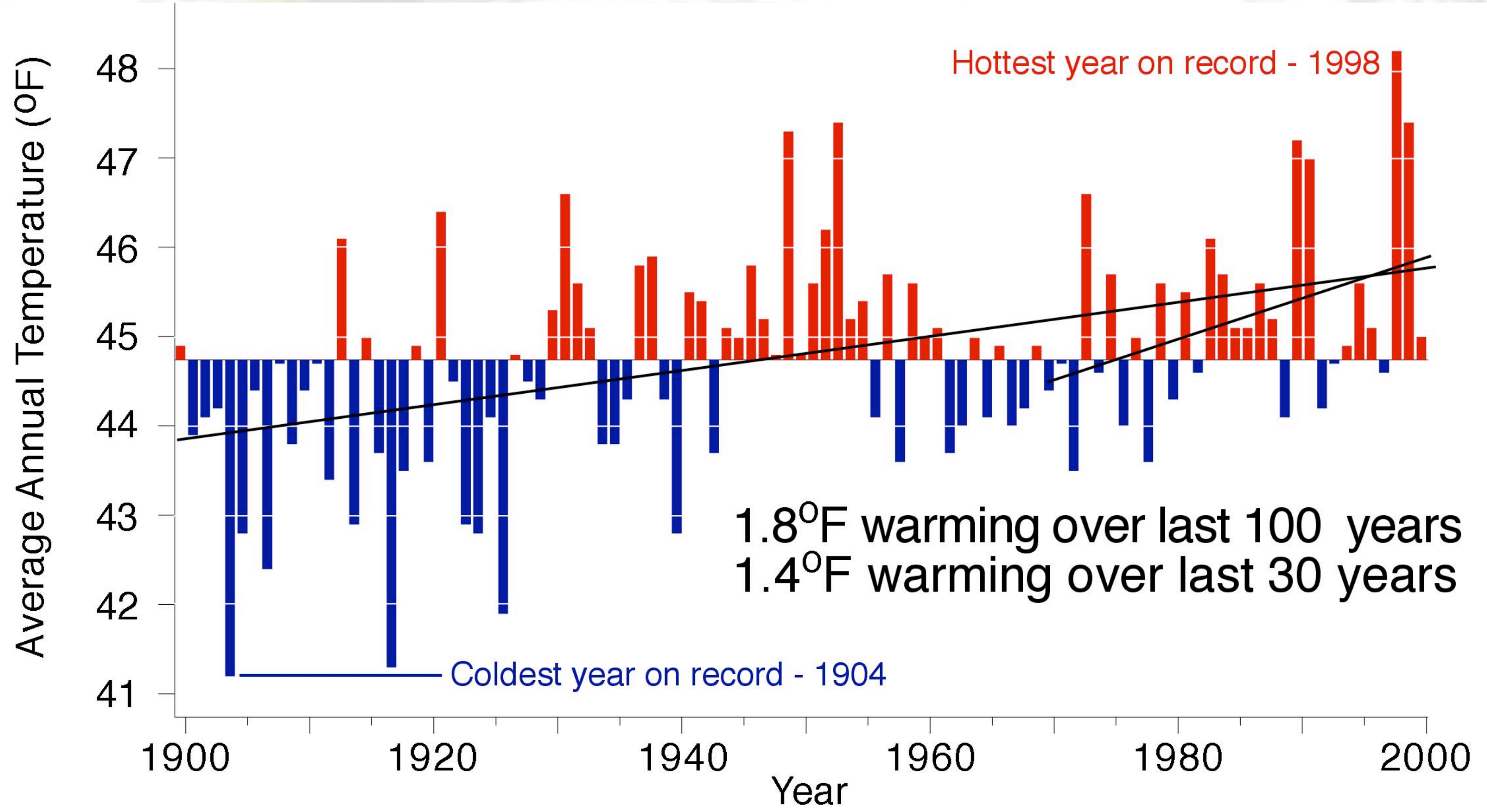
Source: Friedman, et al, *JAMA,* 2001

Results: Total Non-Asthma Related Acute Care Visits
1-16 year old residents of Atlanta



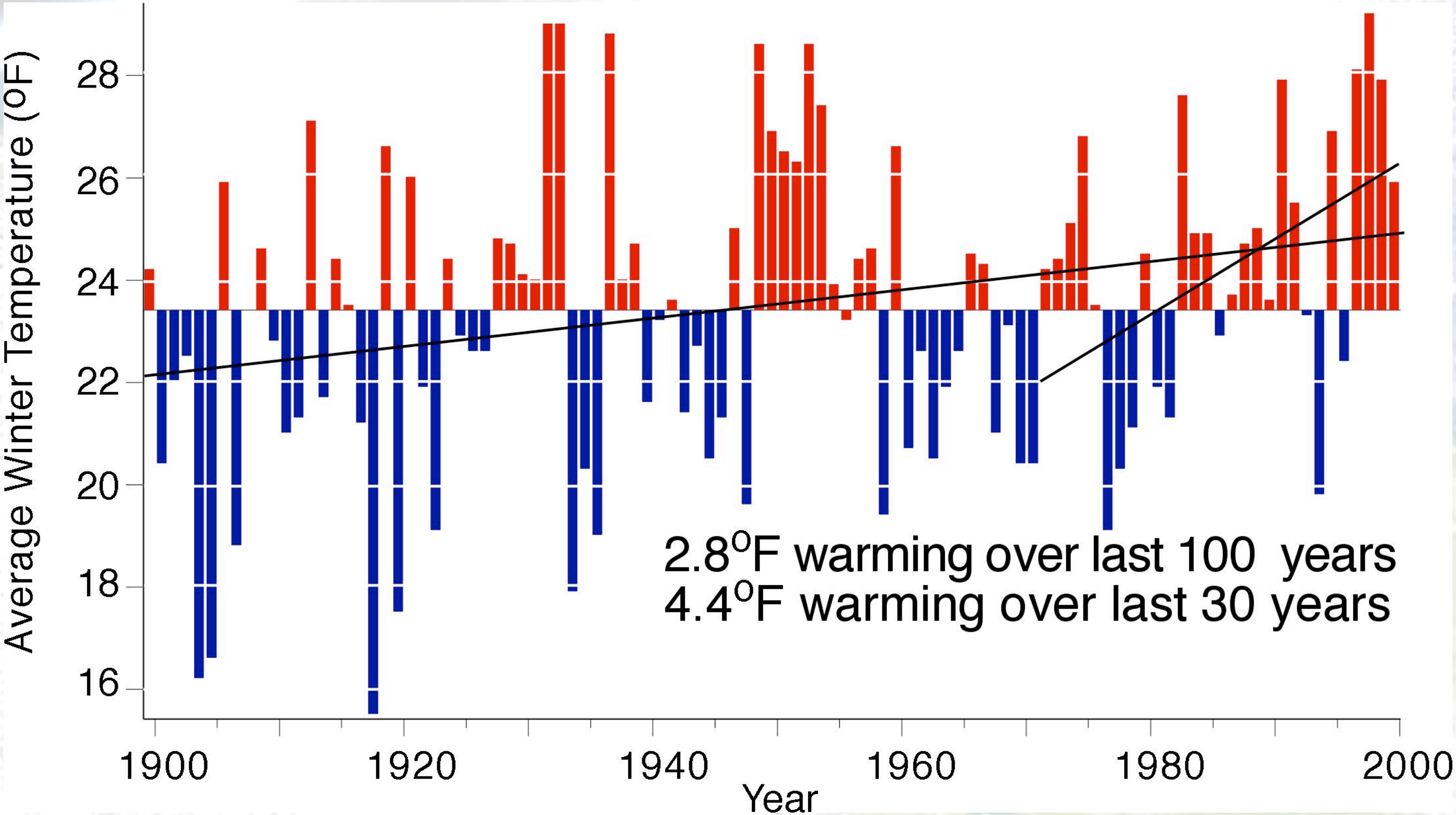
***July 19 –August 4, 1996**
Source: Friedman, et al, *JAMA,* 2001

Average Annual Temperature in the Northeast 1899-2000



Time-series represents an areally weighted average of data from 56 stations in the Northeast that have been in operation continuously since 1900.
Data from the NOAA-NCDC (ftp://ftp.ncdc.noaa.gov/pub/data/ushcn).

Average Winter Temperature in the Northeast 1899-2000

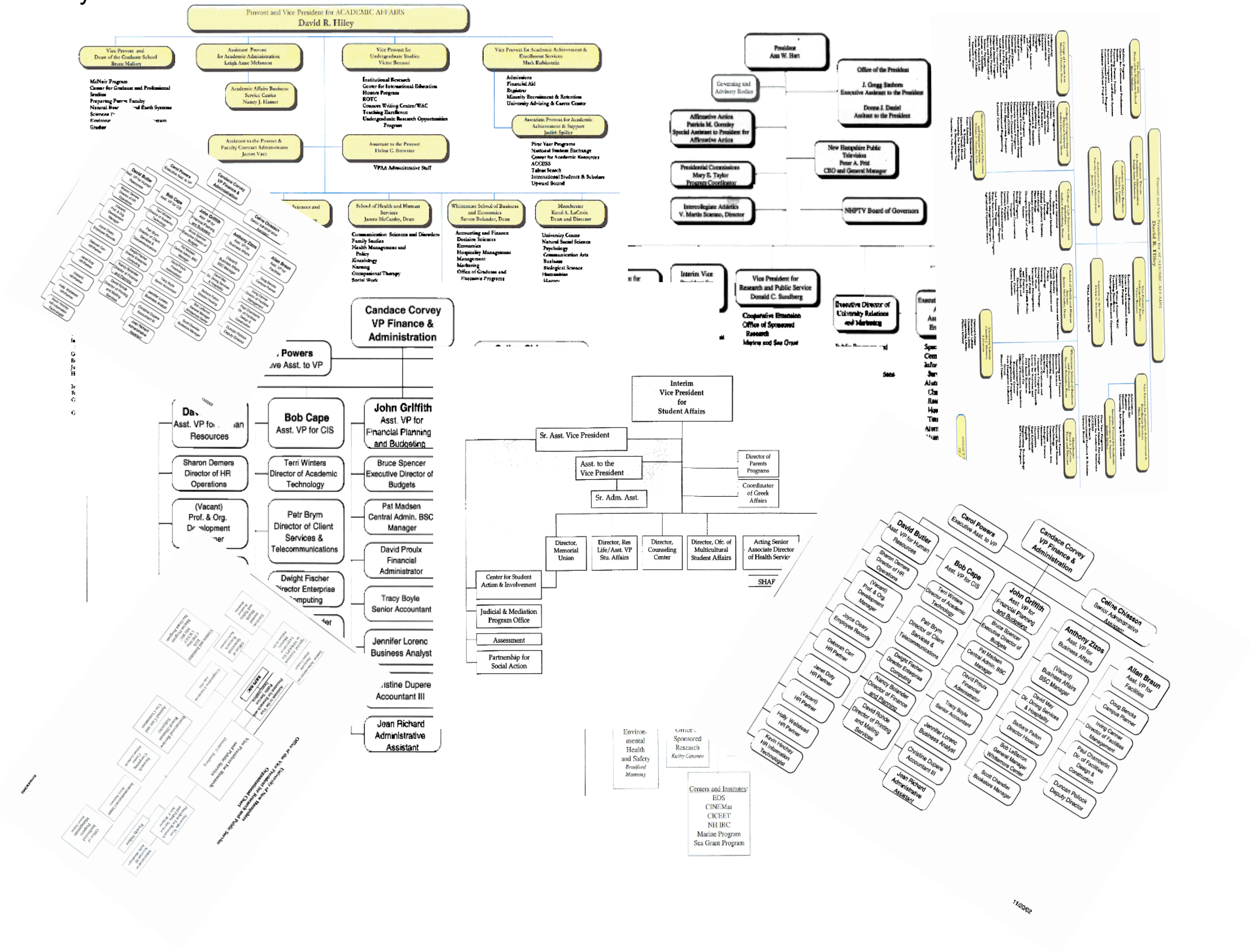


Time series represent areally weighted average of 56 meteorological stations.

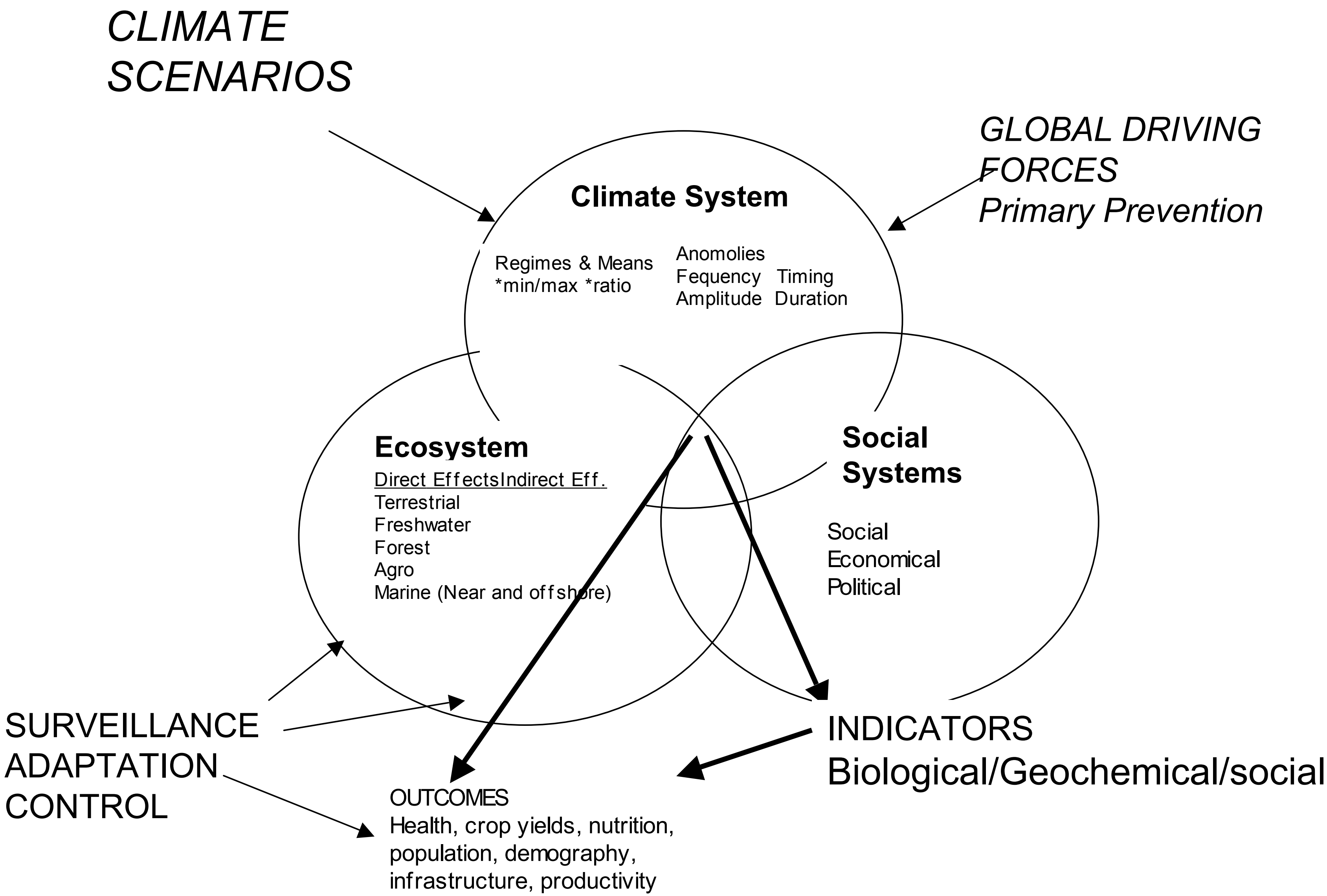
ON THE BEACH

New England
Integrated Sciences & Assessment

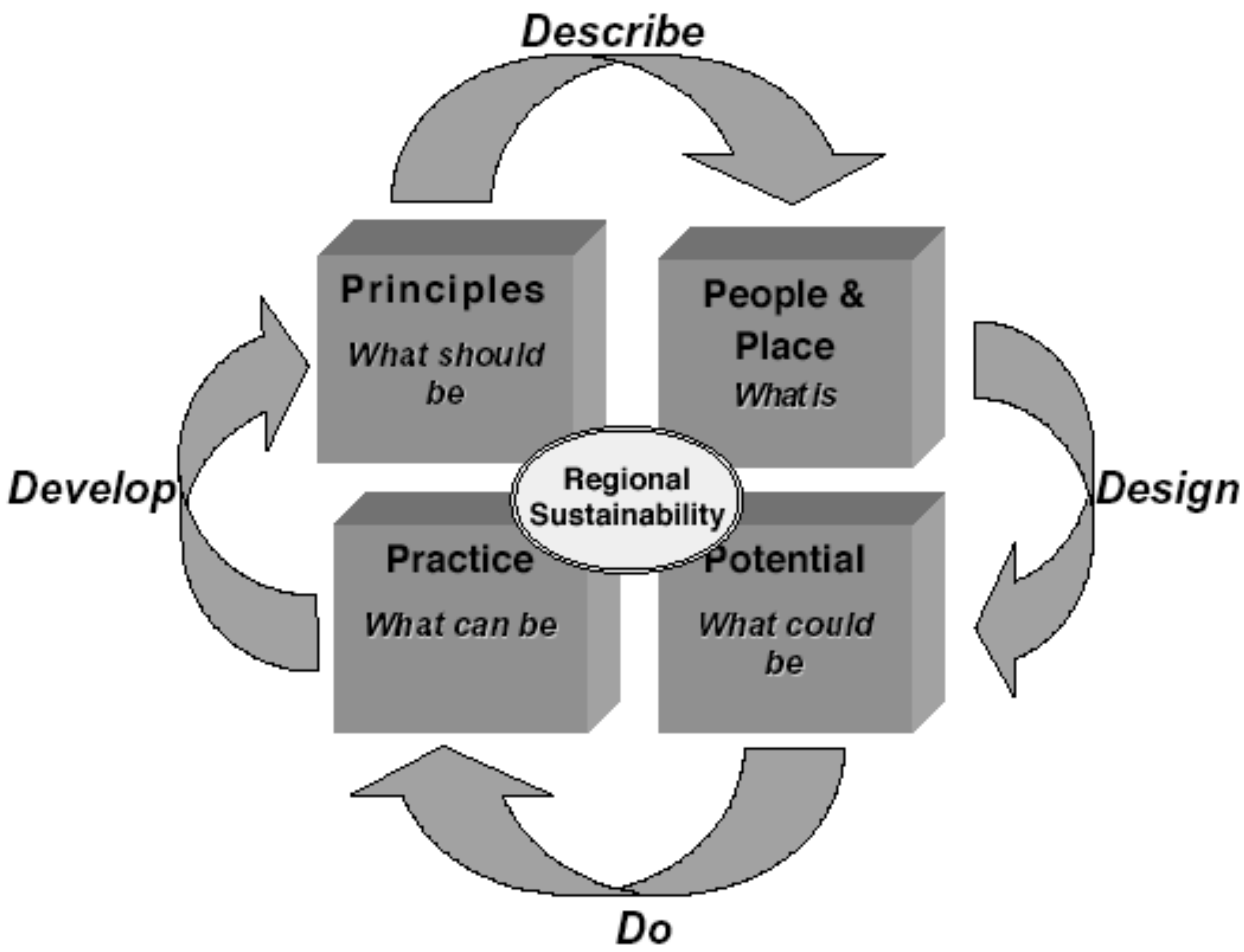
T. Kelly PHP 930/05 Introduction: Reflect/Describe/Frame



New England
Integrated Sciences & Assessment

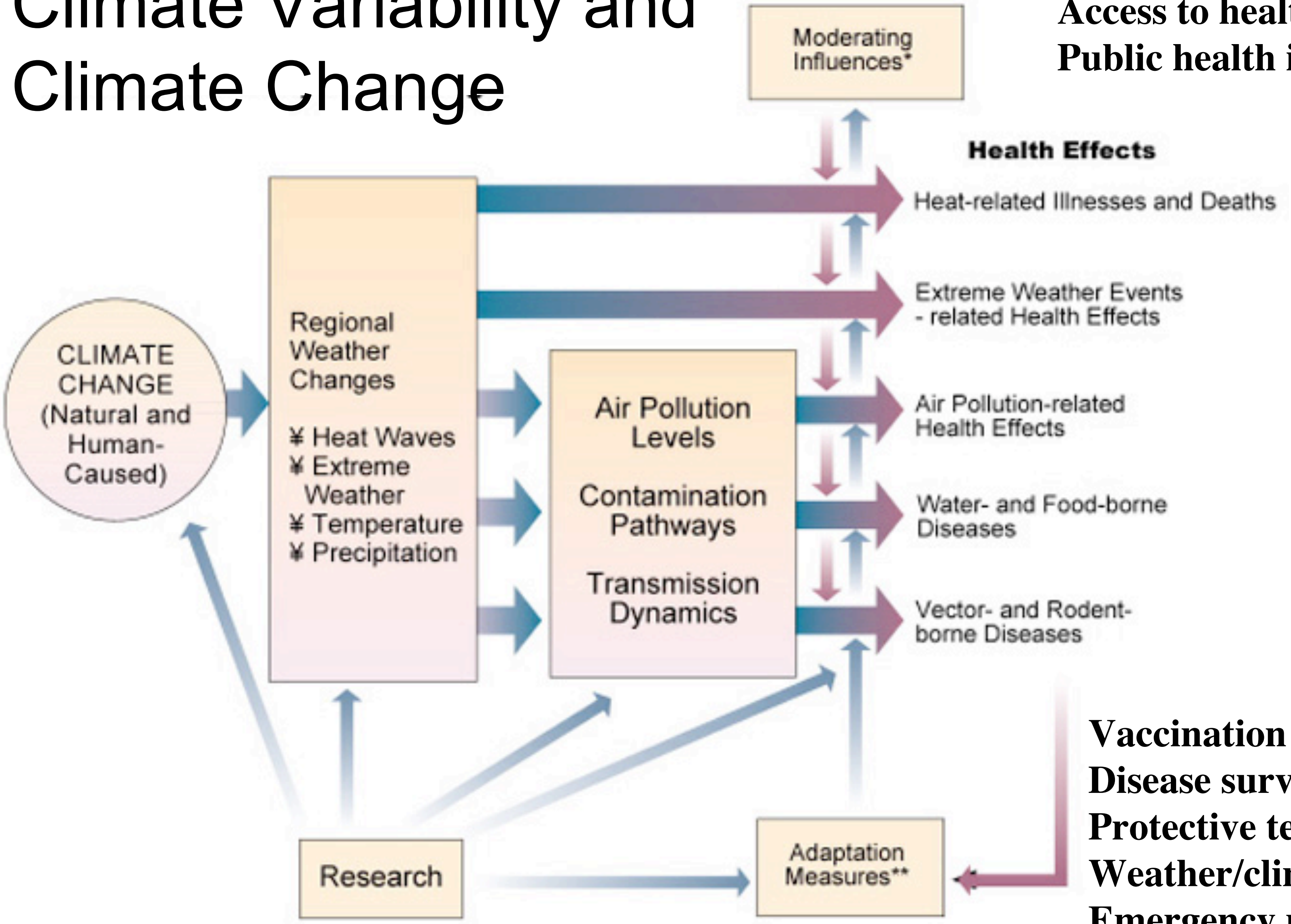

CLIMATE SCENARIOS
GLOBAL DRIVING FORCES
Primary Prevention
Climate System
Regimes & Means
*min/max *ratio
Anomolies
Fequency Timing
Amplitude Duration
Ecosystem
Direct EffectsIndirect Eff.
Terrestrial
Freshwater
Forest
Agro
Marine (Near and offshore)
Social Systems
Social
Economical
Political
SURVEILLANCE
ADAPTATION
CONTROL
INDICATORS
Biological/Geochemical/social
OUTCOMES
Health, crop yields, nutrition, population, demography, infrastructure, productivity

Sustainability Decision-making Processes (D4P4)



Potential Health Effects of Climate Variability and Climate Change

Population
Standard of living
Access to health care
Public health infrastructure



Vaccination programs
Disease surveillance
Protective technologies
Weather/climate forecasts
Emergency management

From: Climate Change Impacts on the United States, 2000. http://www.usgcrp.gov/usgcrp/nacc/

Figure 3.1. Pathways by which climate change affects human health (modified from reference 2)

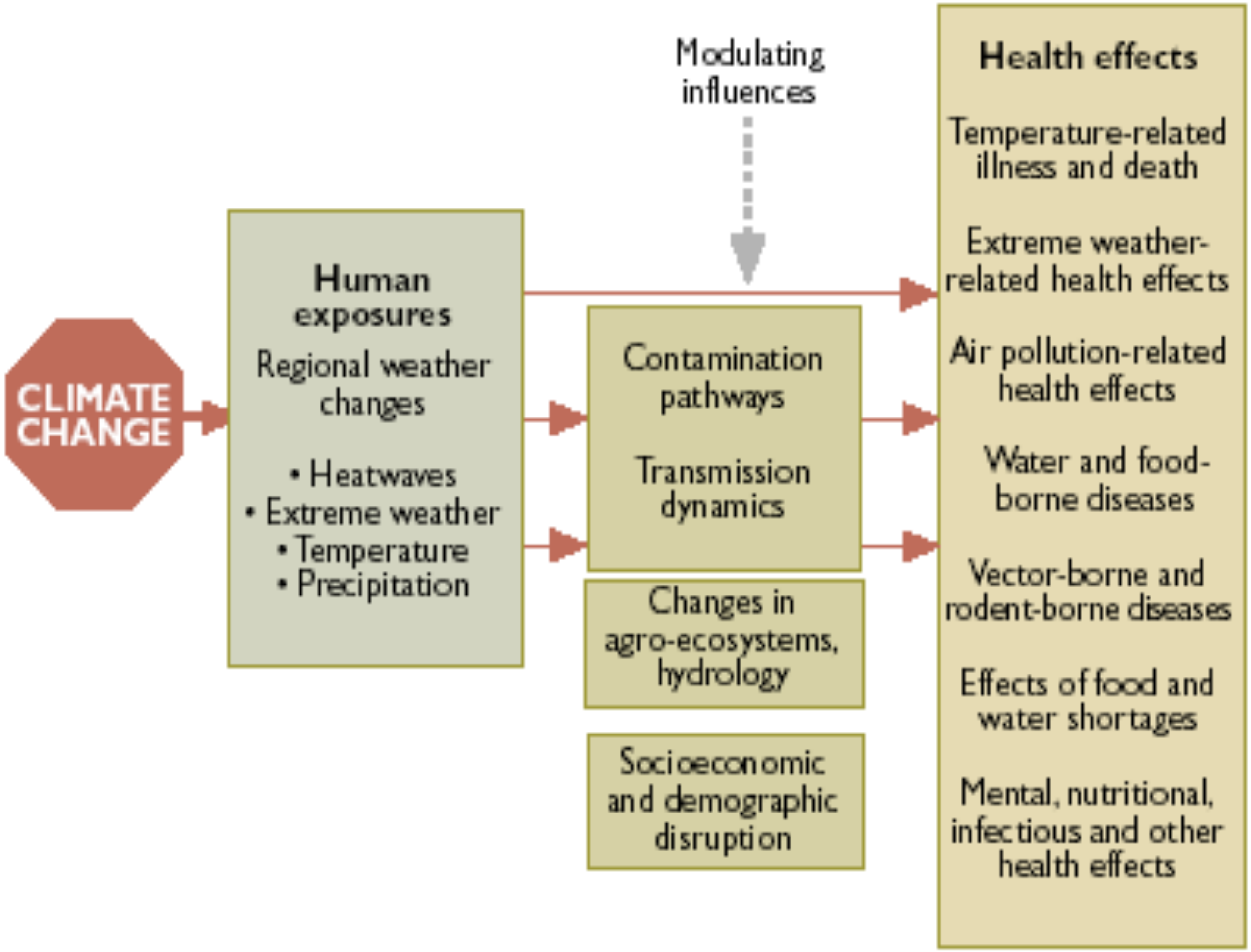
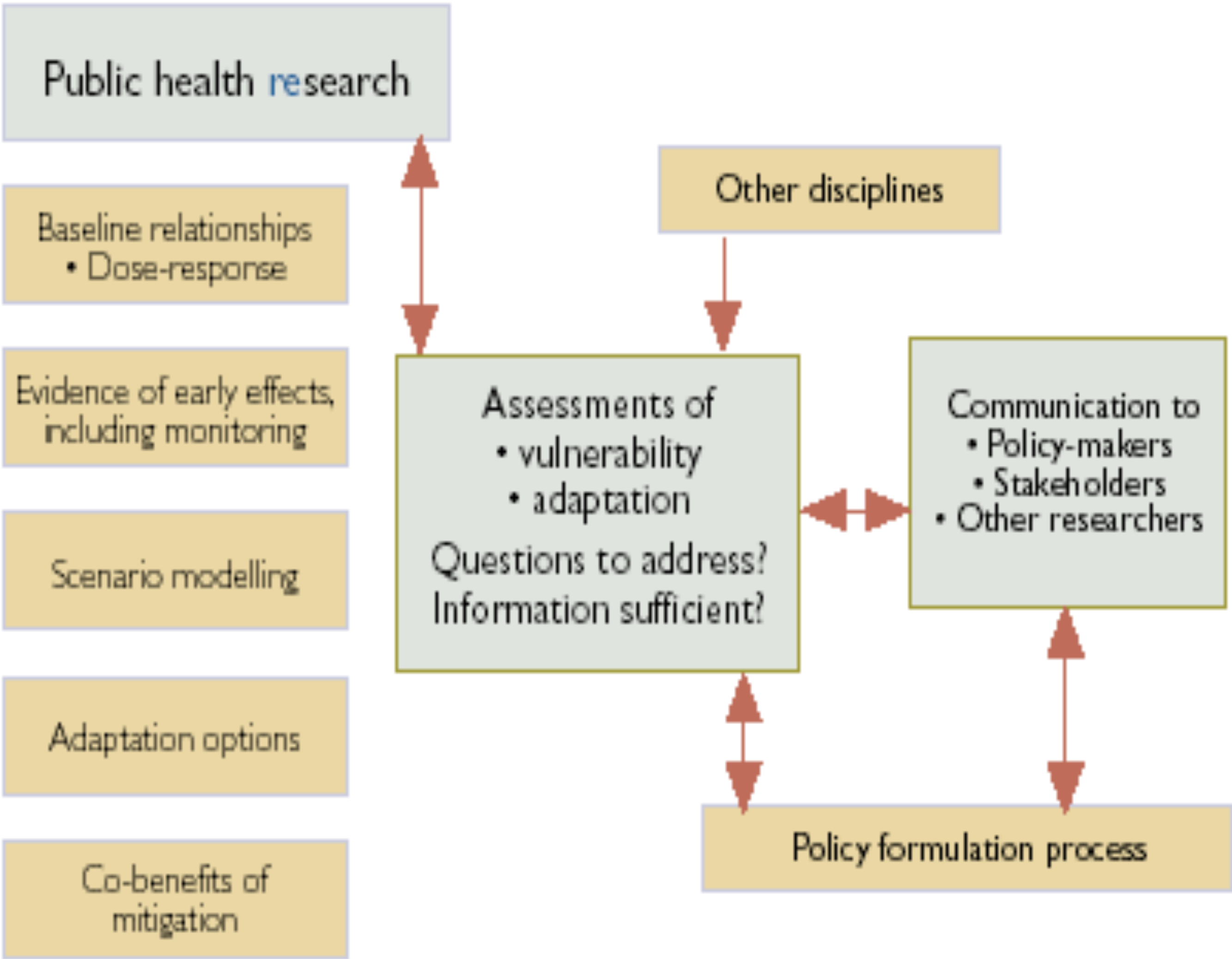
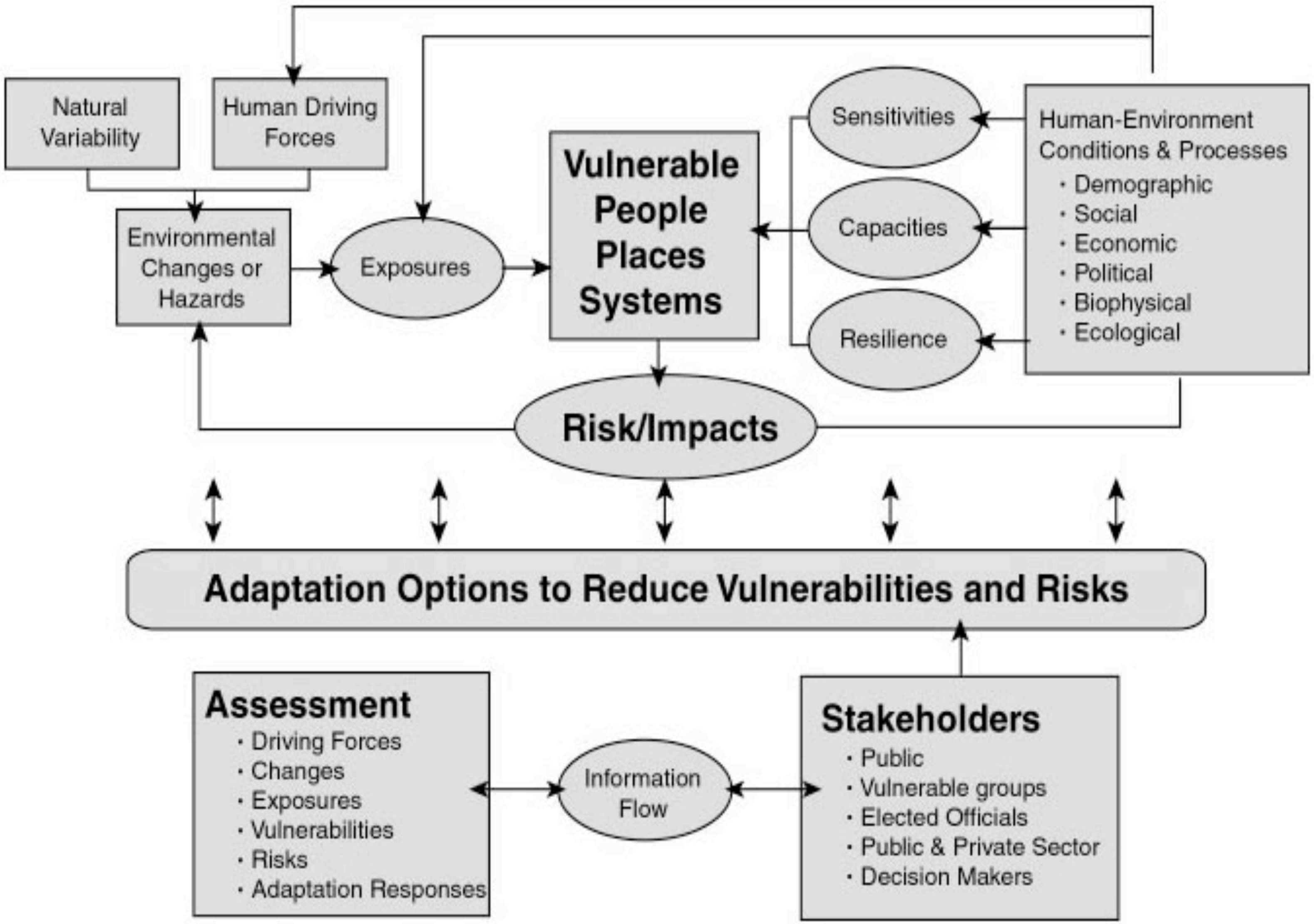


Figure 4.1 Tasks for public health science



New England Integrated Sciences & Assessment



New England Integrated Sciences & Assessment

Major Stakeholders in NEISA

Academic: UNH Departments and Institutes

AIRMAP; Institute for the Study of Earth, Oceans and Space

Office of Sustainability; NH State Climatologist

Whittemore School of Business and Economics

School of Health and Human Services

Masters of Public Health

New Hampshire Institute for Health Policy

New Hampshire Health Information Center

UNH Cooperative Extension

Academic: Other Universities

Northeast Regional Climate Center, Cornell University

Harvard School of Public Health

Columbia School of Public Health

Graduate School of Oceanography, University of Rhode Island

External Stakeholders in NEISA

Governmental Organizations

NH Dept. of Environmental Services & Dept. Health and Human Services

Vermont DEP and Health and Human Services

Maine DEP and Bureau of Health

EPA Region 1

NOAA

Non - Governmental Organizations

Lung Association (NH, Maine, New Brunswick)

Maine Thoracic Society

Asthma Regional Council (ARC) of New England

Exeter, Portsmouth and Wentworth Douglas Hospitals

NH Community Health Access Network

Dartmouth Hitchcock and Penobscot Bay Medical Center

John Snow Institute

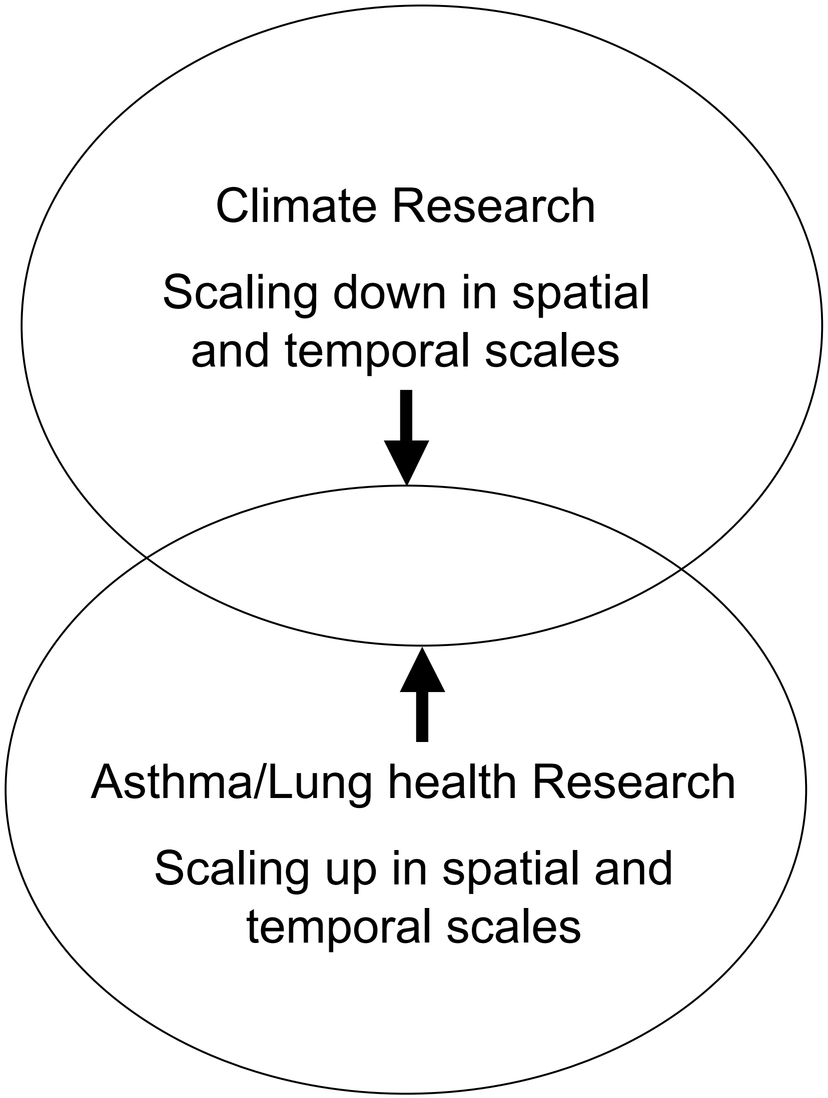
Physicians for Social Responsibility

New England Society of Allergists (NESA); Variety of Allergy Clinics

CISCO, Timberland, HMOs?

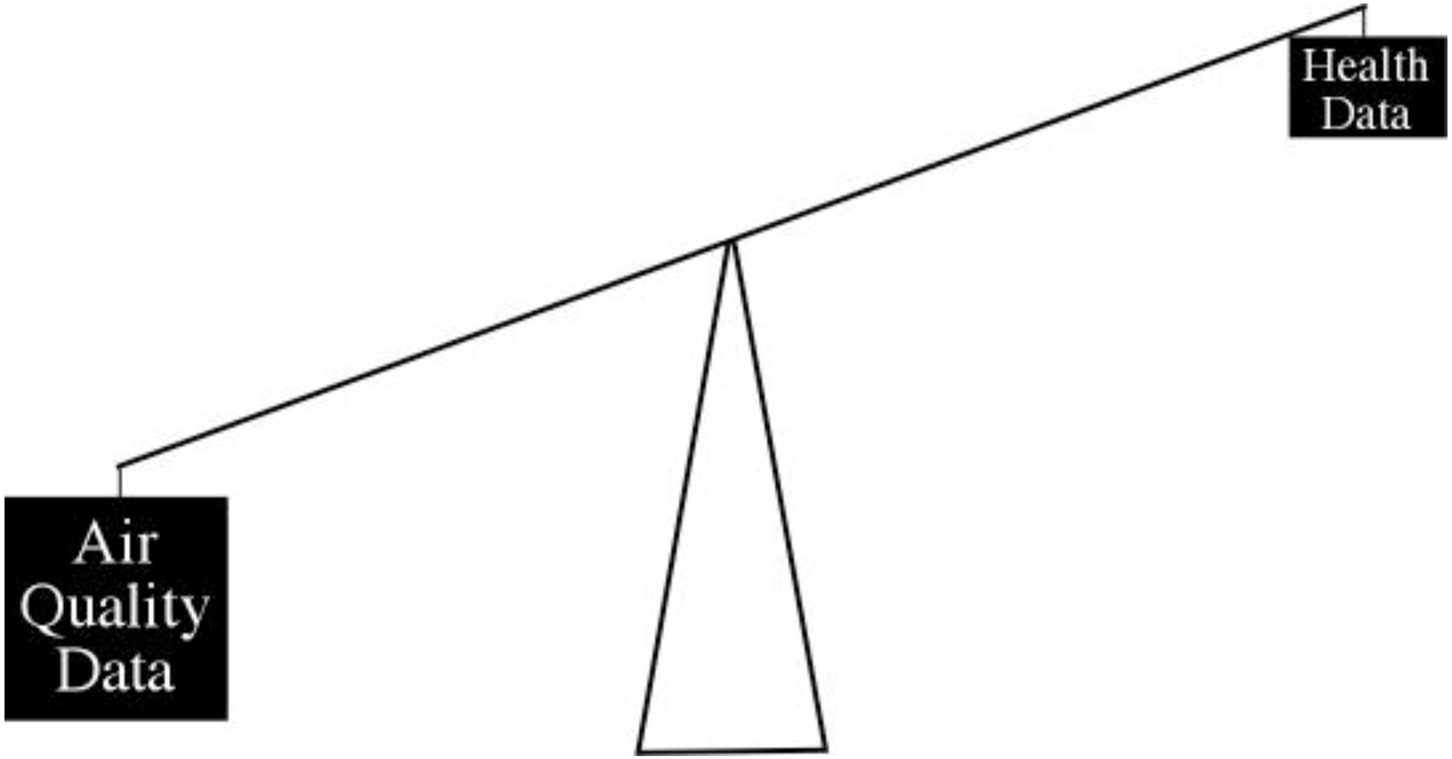
How do we develop our process for eliciting stakeholder needs/wants?

- Began with information gathering from groups and individuals
- Tapped in engaged networks in different sectors interested in climate-health-air quality (e.g., public health officials, health care providers, NGOs, academia)
- Listened respectfully to our stakeholders
- Presented ourselves as potential partners, not experts
- Responded to stakeholder input; provided feedback to stakeholders
- Built upon previous experiences



New England
Integrated Sciences & Assessment

Problem Statement

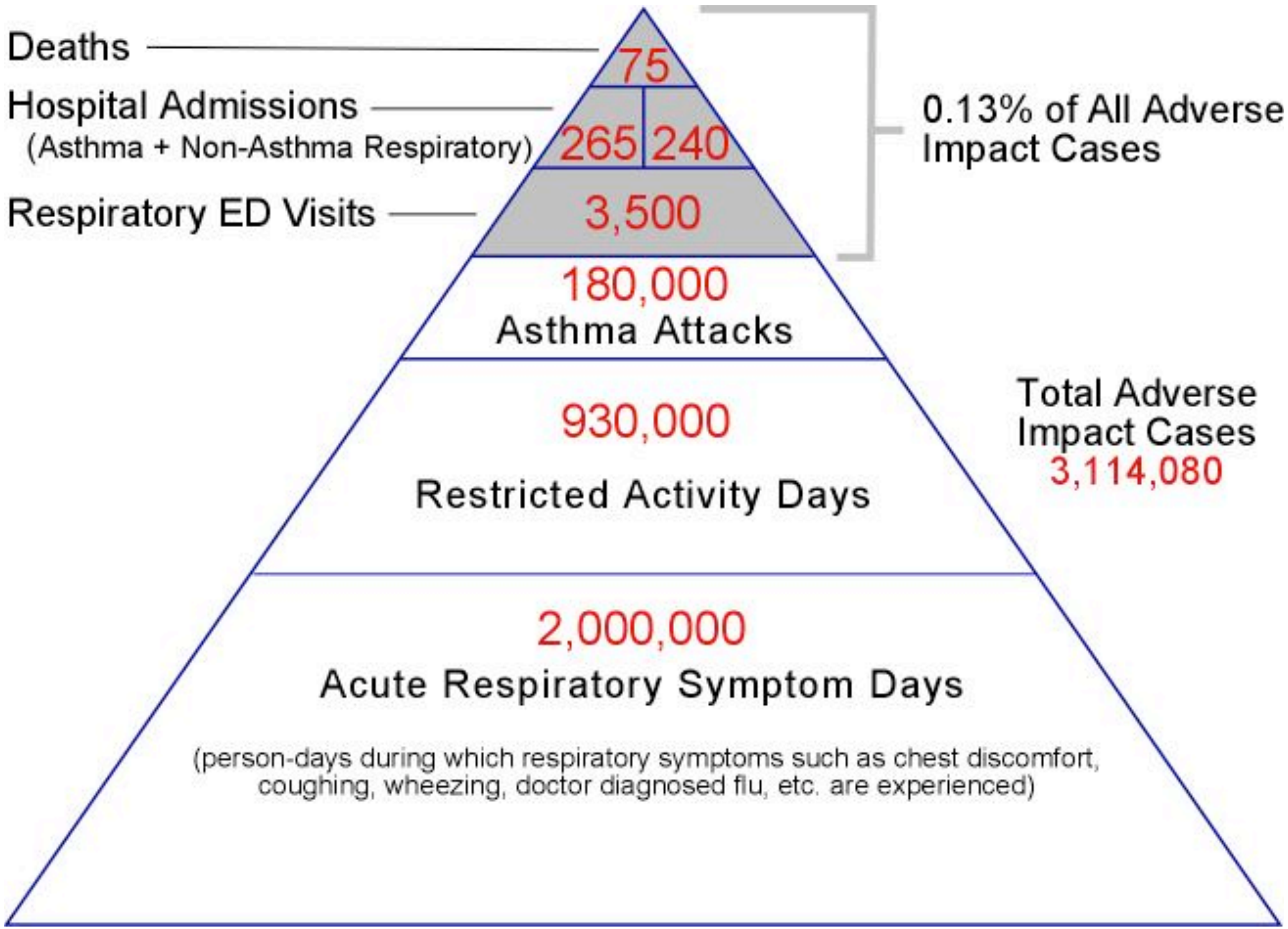


Air Quality Issues
- -indoor vs outdoor
- -year round meas.
- -multi-parameter
- -discontinuos (e.g. toxics)

Health Tracking Issues
- -access
- -coarse spatial and temporal resolution
- -what to track
- -tip of iceberg

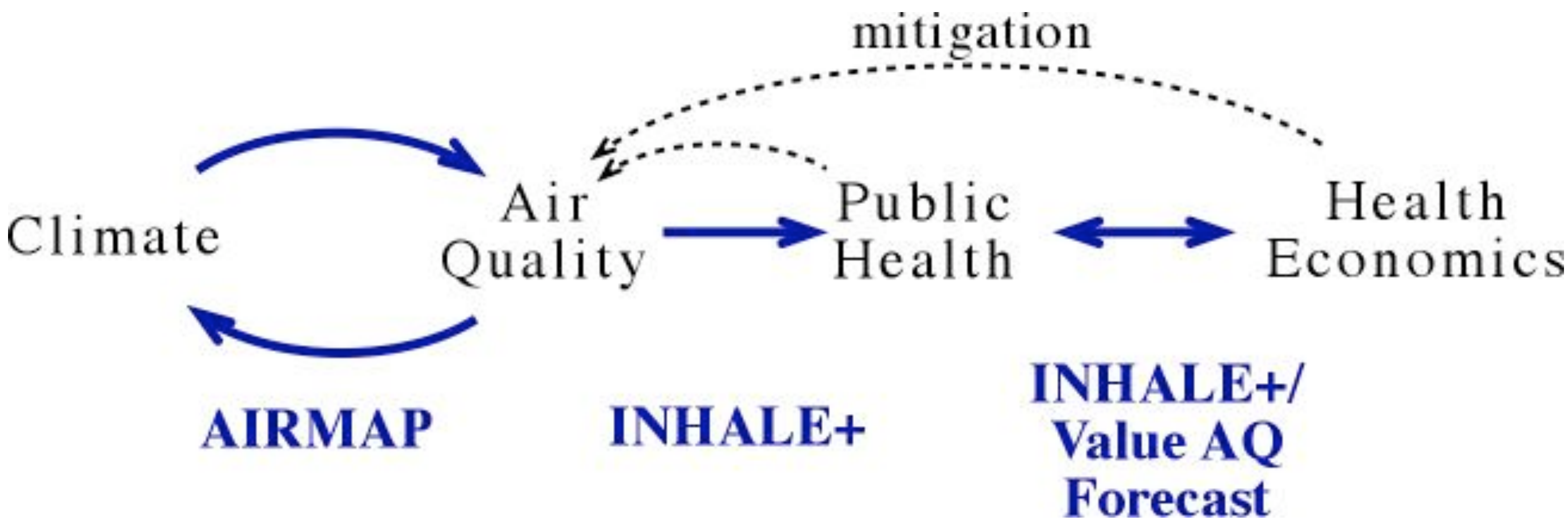
New England Integrated Sciences & Assessment

"Tip of the Iceberg"



From Thurston, 1997.

Conceptual Framework



New England Integrated Sciences & Assessment

Including stakeholders in research planning, implementation, and reporting

Creating & Supporting a Learning Community

- *Early and continued communication*
- *Working meetings, conference calls*
- *Frequent e-mail and phone calls*
- *Surveys and interviews*
- *Formal science presentations*
- *Shared funding of joint efforts*
- *Invited presentations at professional meetings*
- *Web, streaming displays with real-time AQ information*

Stakeholder Needs⇒⇐ NEISA Capabilities

Systematically managed expectations:

- *NEISA as co-stakeholder, not "The Experts"*
- *Strong stakeholder interest in quantifying economic impacts of air quality to impact policy*
- *NEISA incorporated health economics and business management faculty into project.*

Strategic Networking to broaden NEISA expertise and access to data (URI, HSPH)

Stakeholder Identification and Influence?

Evolution of the Learning Community

•*Stakeholders identified by networks of individuals already engaged in the learning community*

•*Most influential stakeholders are those that share the integrated assessment approach/philosophy and manage their boundaries with porous/networking outlook.*

•*NEISA is working with "early adopters" of the integrated approach from multiple sectors which is leading to the identification of new stakeholders.*

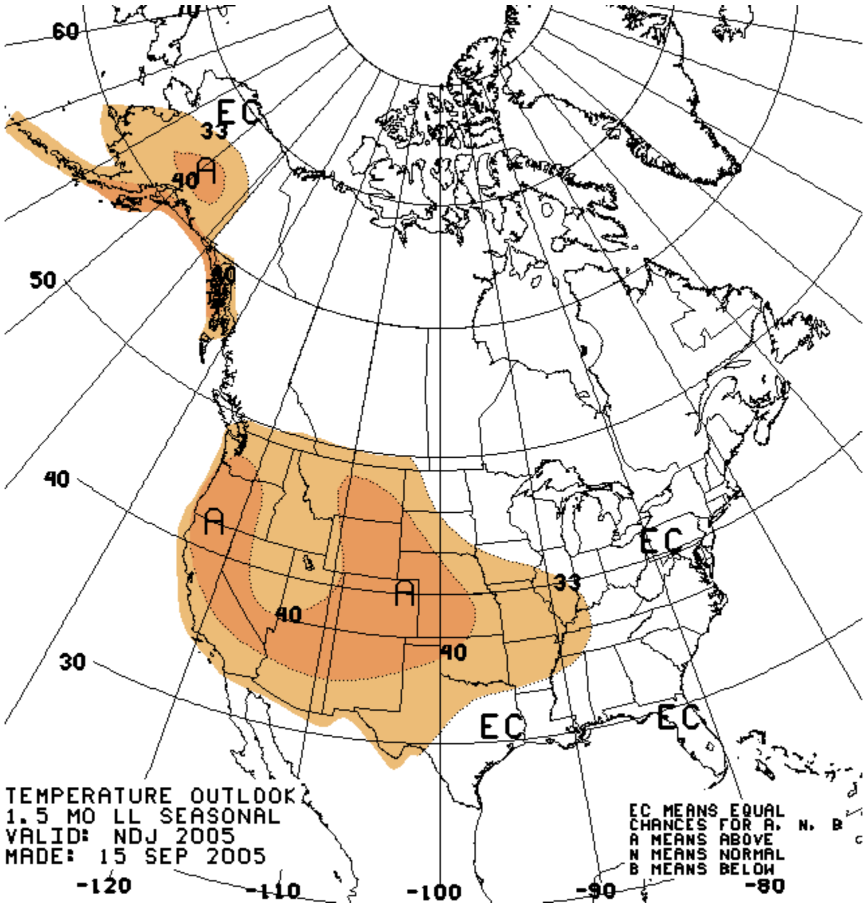
Lessons from NEISA

It is less a market and more a learning community

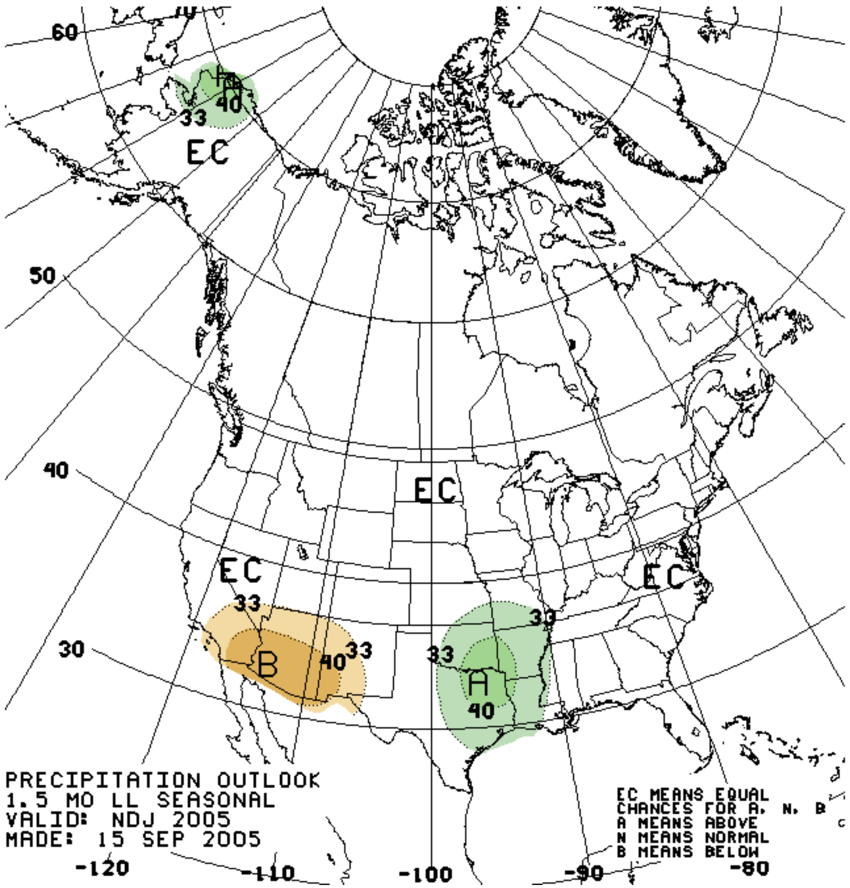
- *Develop knowledge networks and learning communities organized around sustaining health and integrity of populations, ecosystems and institutions through integrated approaches to science and policy.*

Seasonal Climate Outlook - NDJ

Temperature

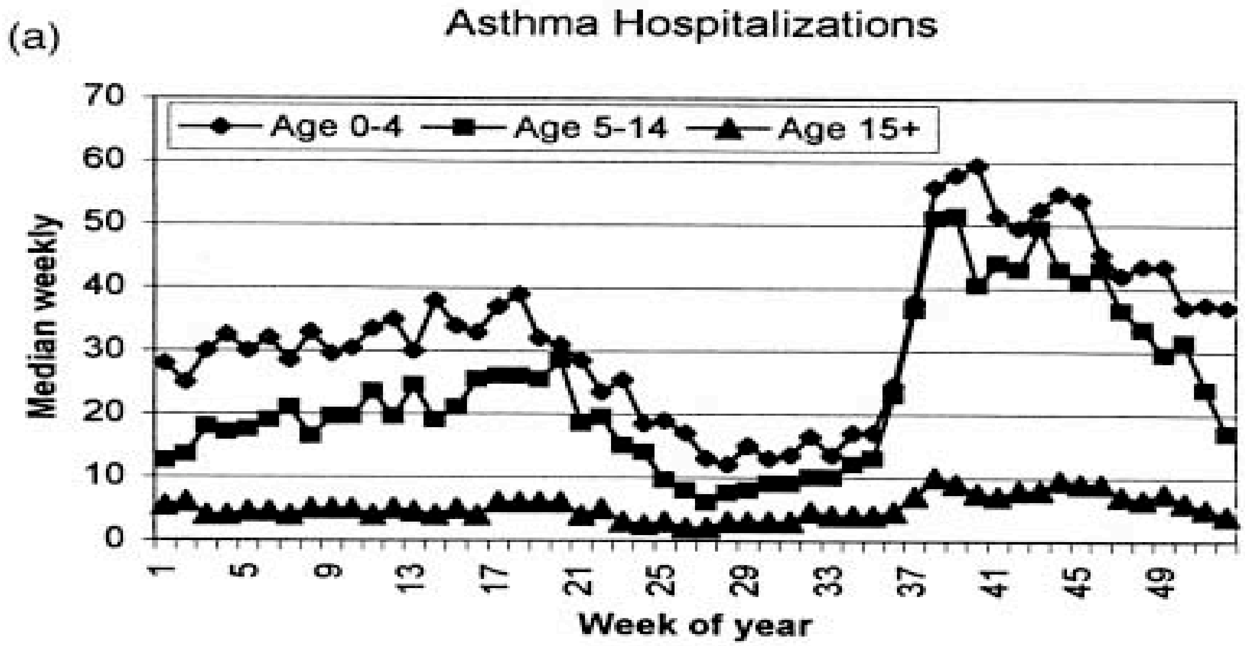


Precipitation



http://www.cpc.ncep.noaa.gov/

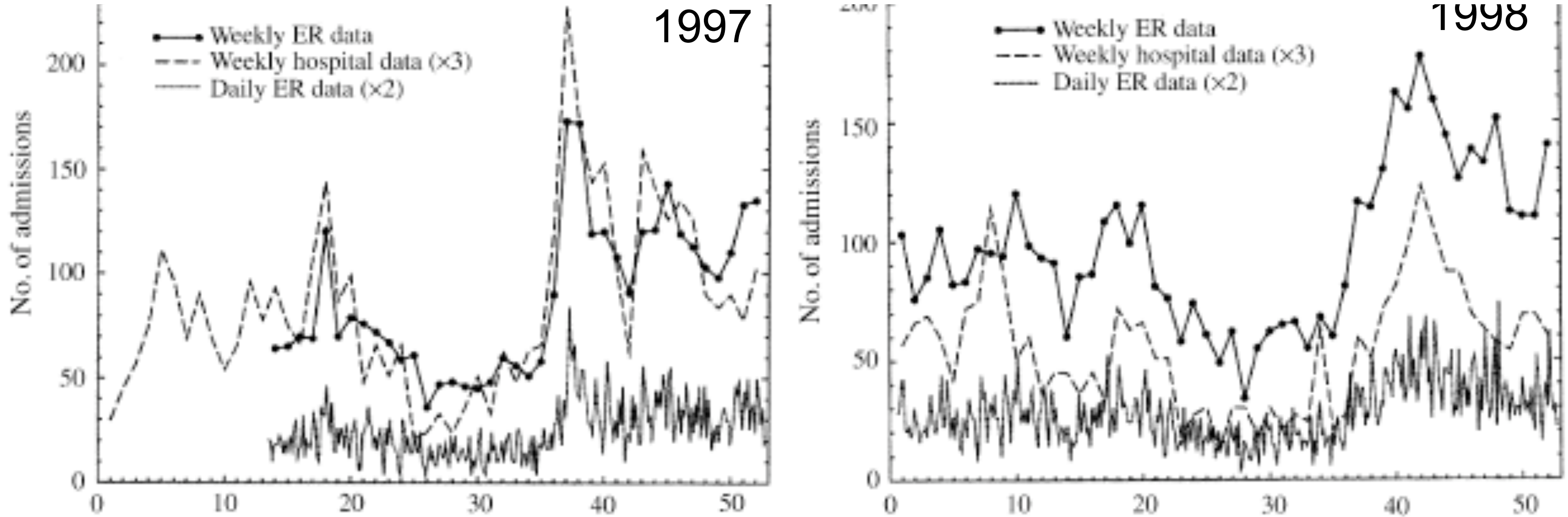
2.1 Fall Rise in Demand for Hospital Services. Forecast of Opportunity

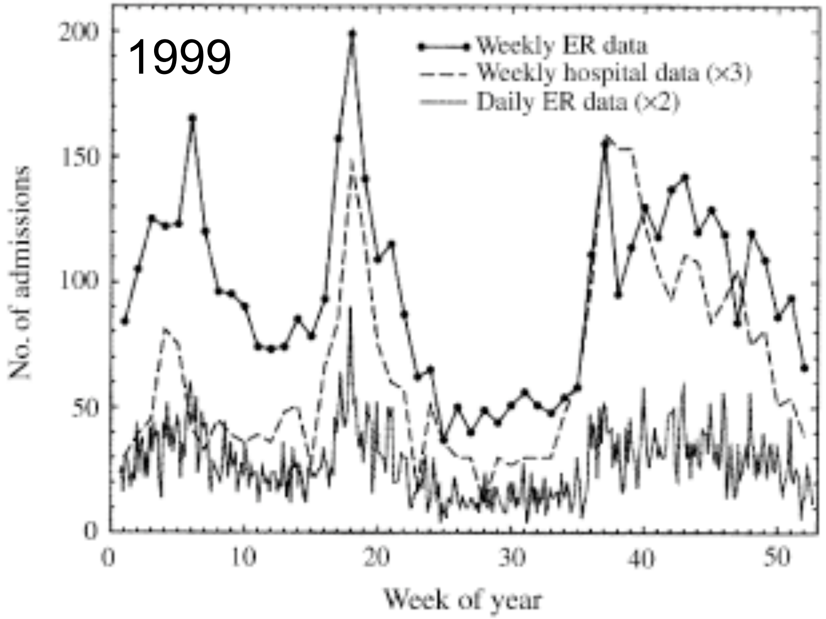


Seasonal Variations in Hospital Admissions for Asthma Maryland 1986-1999. *Blaisdell et al., 2002, J Asthma 39*

New England Integrated Sciences & Assessment

Seasonal Variations in Emergency Dept. Visits for Asthma,   Maryland 1986-1999





Daily and weekly ED visits and weekly hospital admissions (ages 0–18 years old) for Baltimore city. *Kimes et al., Environmental Research, 2004.*

Seasonal Variations in Hospital Admissions for Asthma Maine 1980-2001

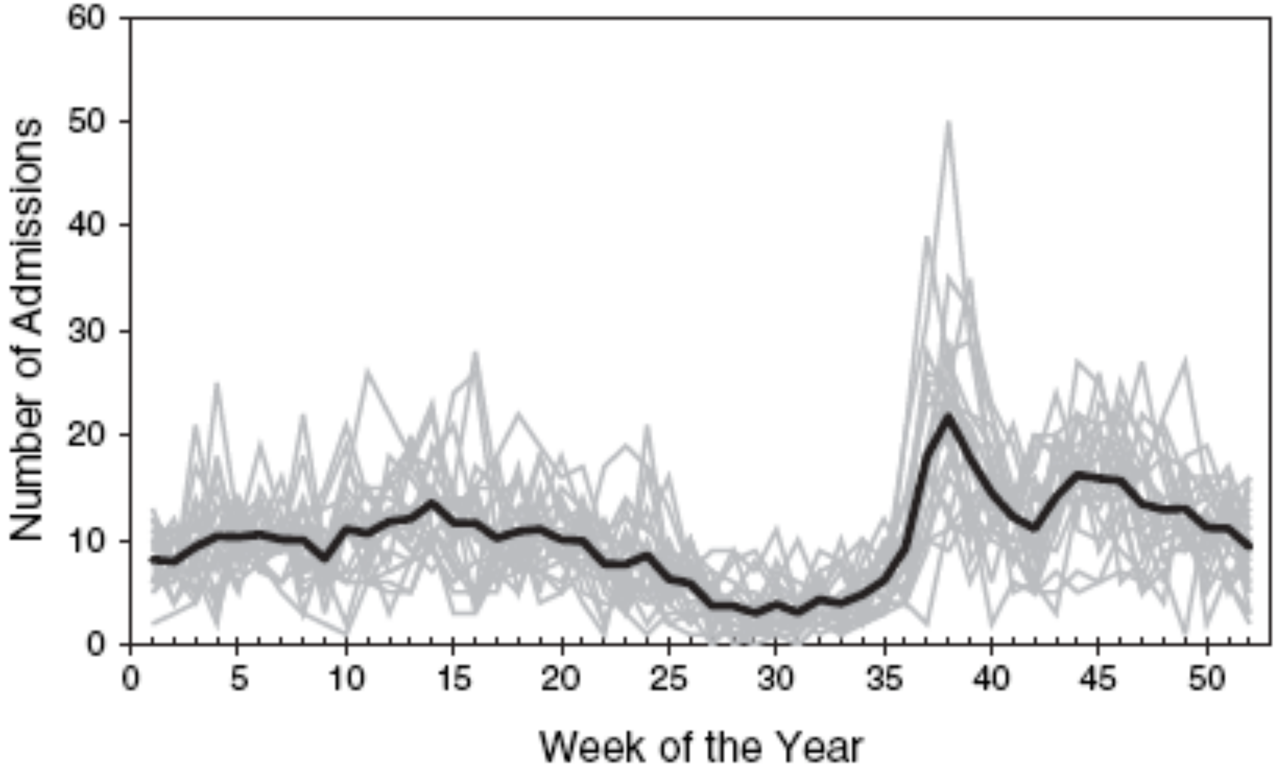
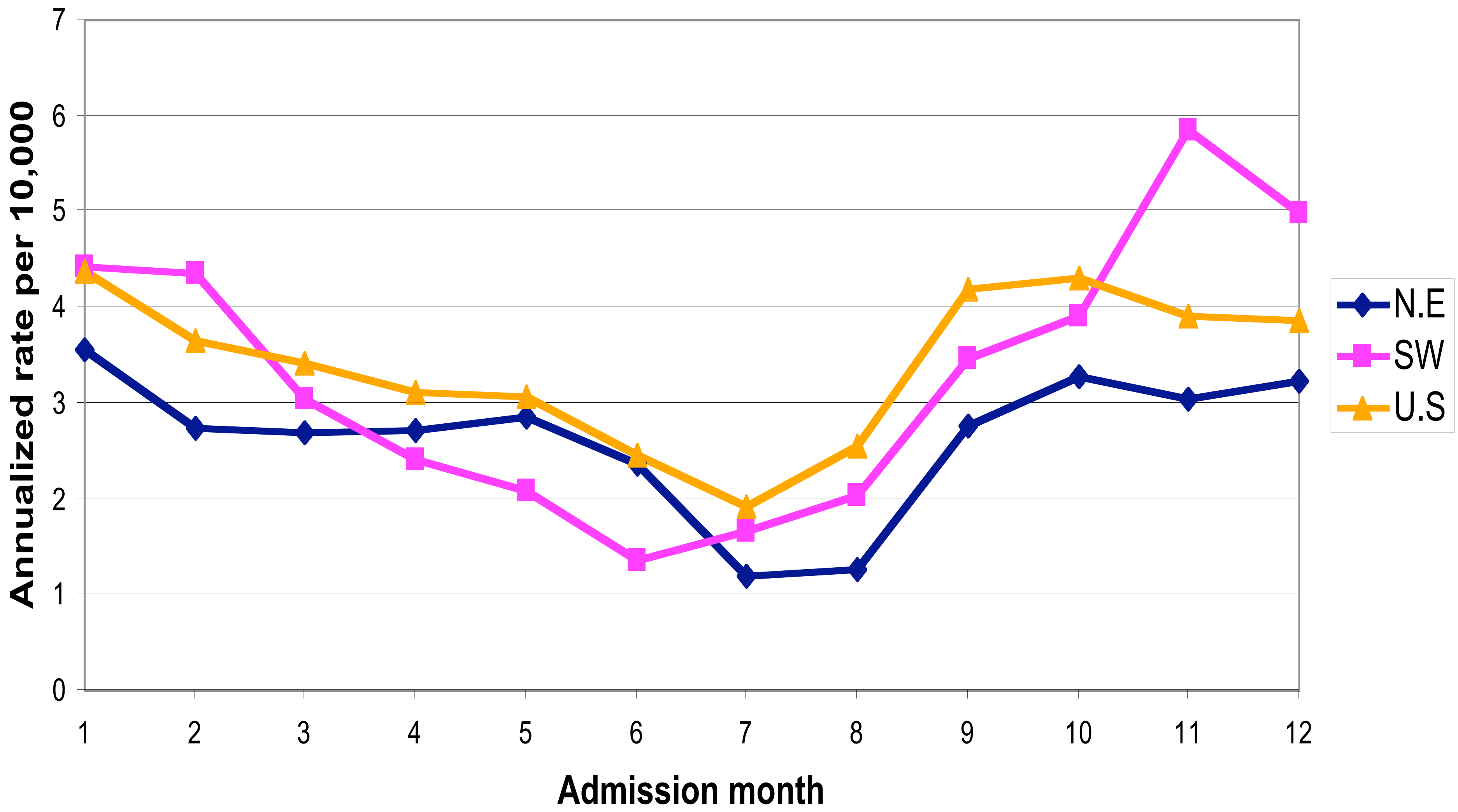


Figure 3. Maine weekly paediatric IP asthma admissions from 1980 to 2001.

Langley-Turnbaugh et al., 2005, Toxicology and Industrial Health

2000 Asthma Hospital Admissions for the United States

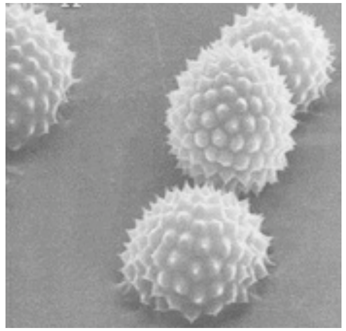


Data from HCUP Nationwide Inpaient Sample for selected states

New England
Integrated Sciences & Assessment

Ragweed

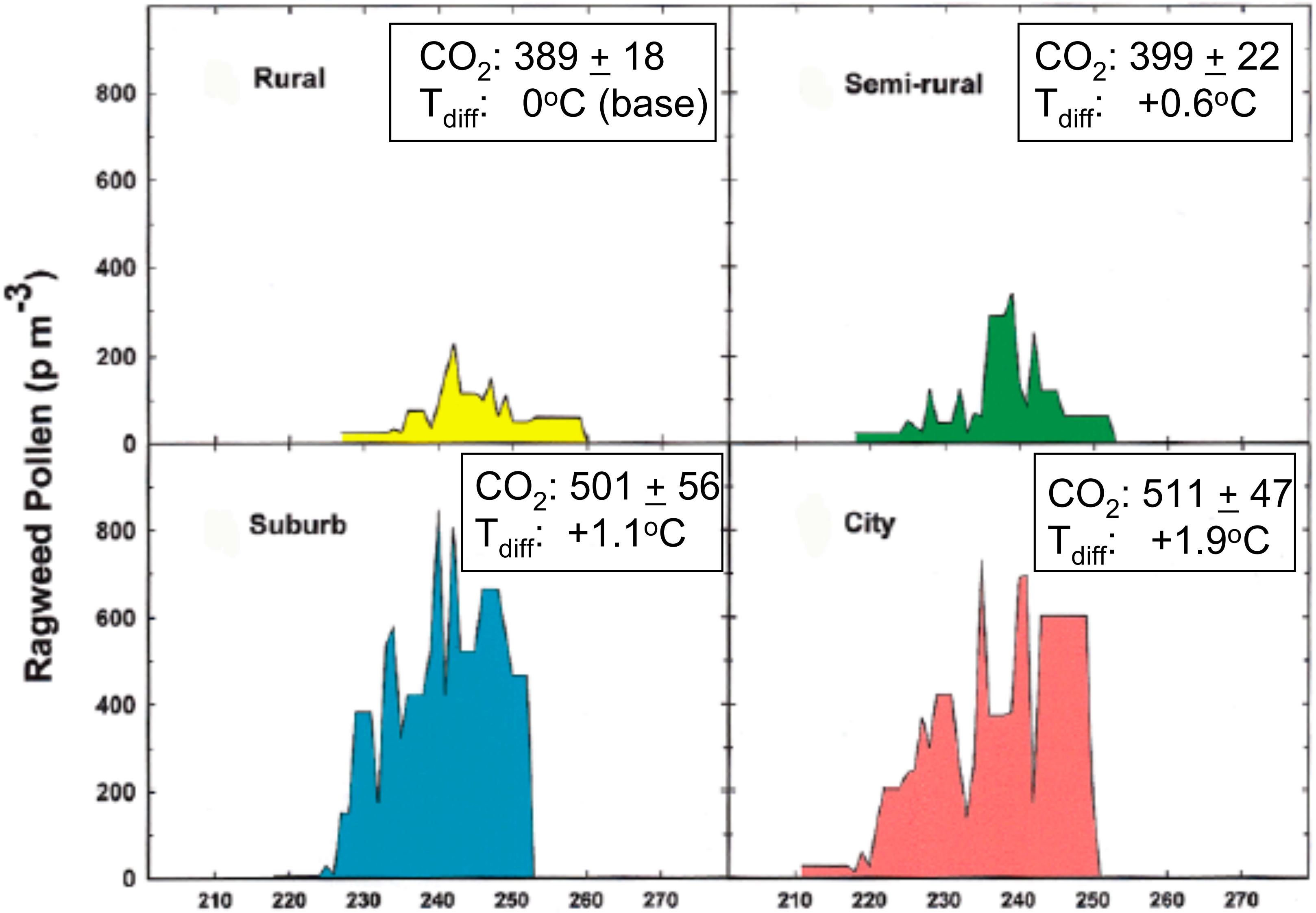
- Ragweed blooms #1 cause of fall hay fever (allergic rhinitis) symptoms
- Allergenic rhinitis results in 3.8 million missed work/school days each year
- > 30% of allergy sufferers said allergic rhinitis decreases their work effectiveness
- Economic impact of allergic rhinitis > $3 billion annually in the United States
- Increased levels of CO_2 results in increased production of ragweed pollen

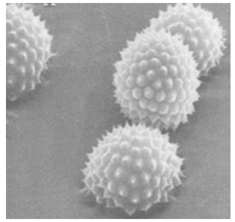


AMERICAN ACADEMY OF ALLERGY ASTHMA & IMMUNOLOGY

www.aaaai.org

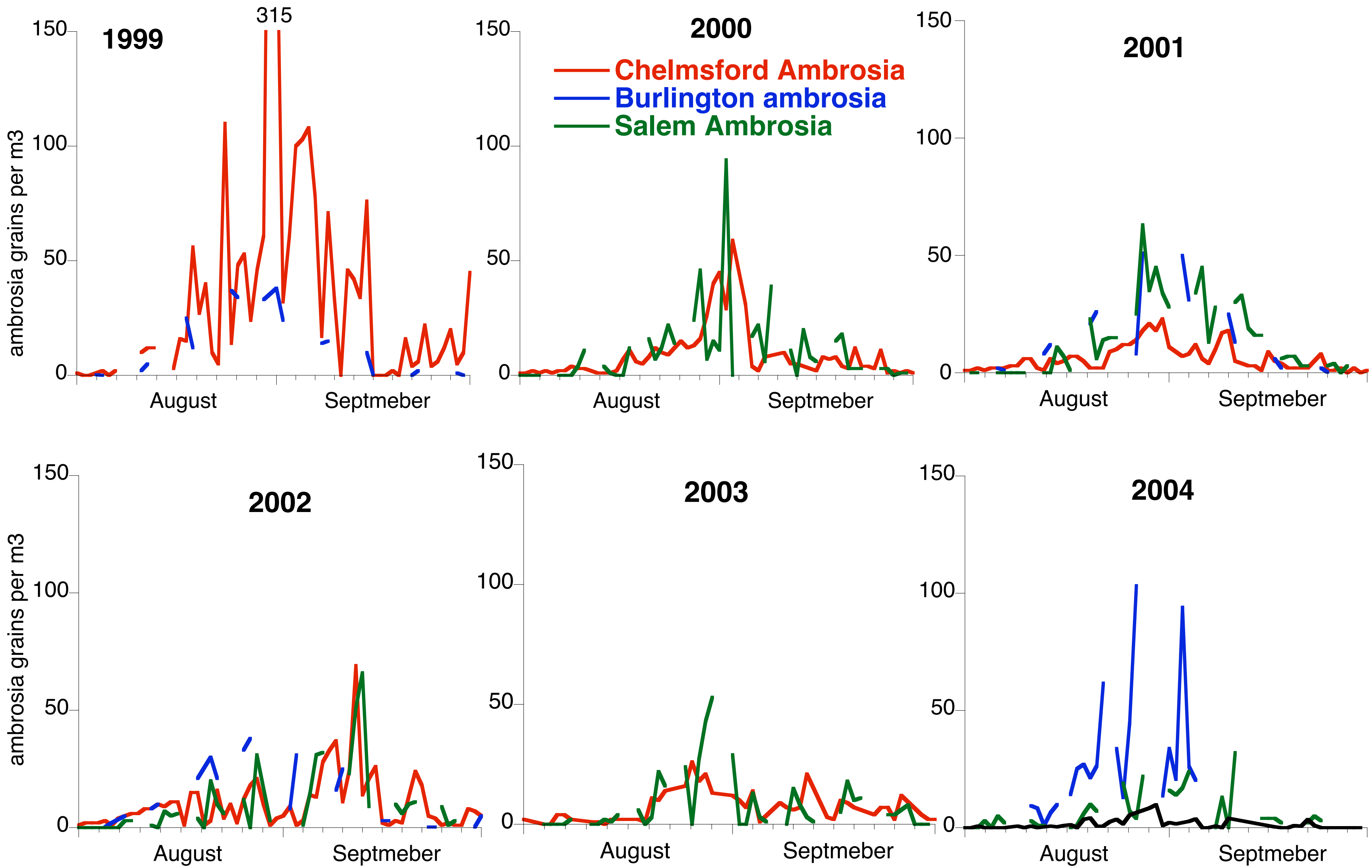
Ragweed Response to Elevated CO_2 and T





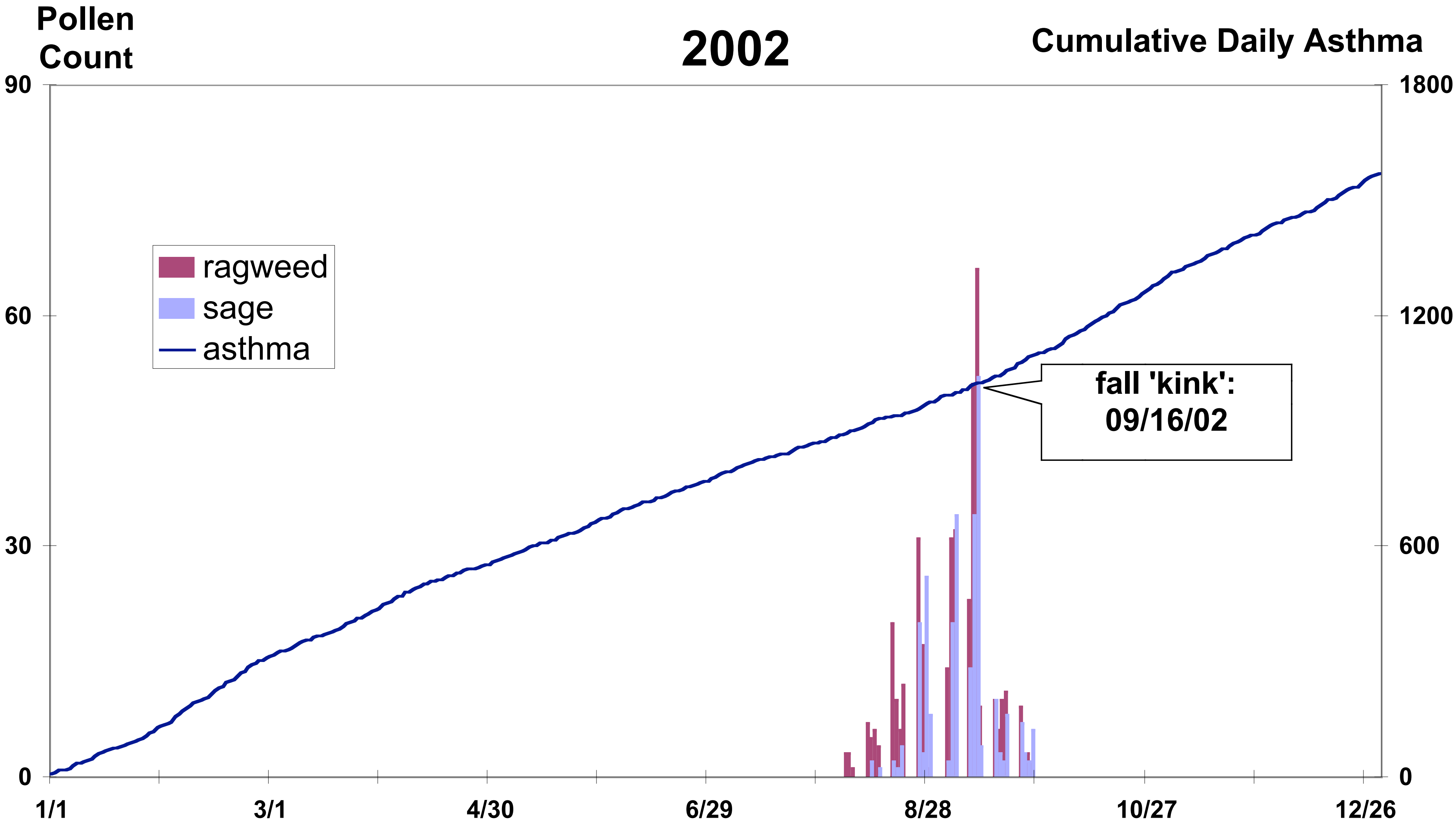
Time course of ragweed pollen production for 4 sites along an urban transect for 2001 as a function of day of year. CO_2 (ppmv) and temperature difference data for day of year 93 to 271 (approximate growing season for ragweed) *Ziska et al., 2003, J. Allergy Clinical Immunology.*

Ragweed in NE Massachusetts 1999-2004



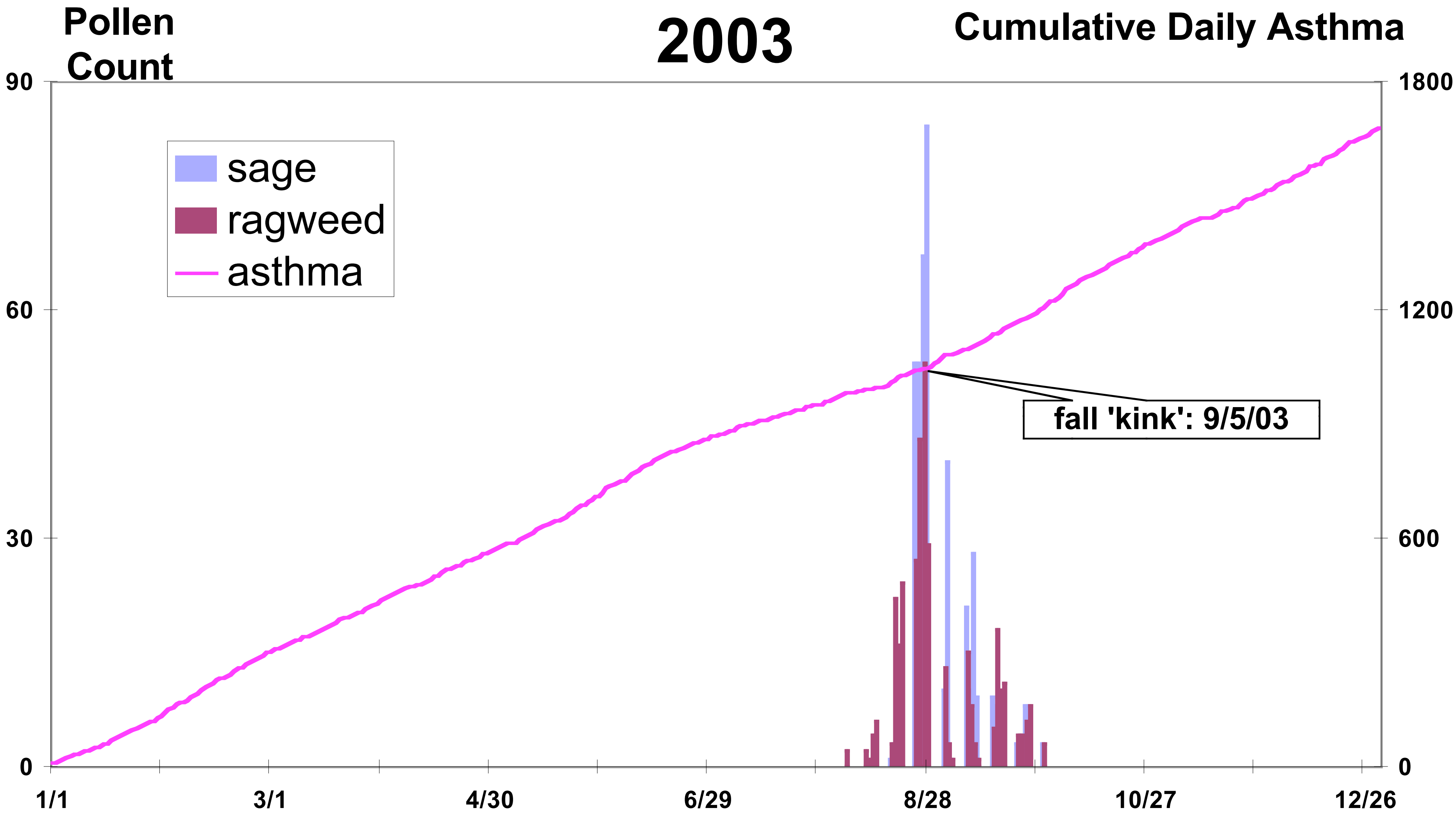
New England
Integrated Sciences & Assessment

Seacoast Hospital Asthma Admissions vs. Salem Pollen



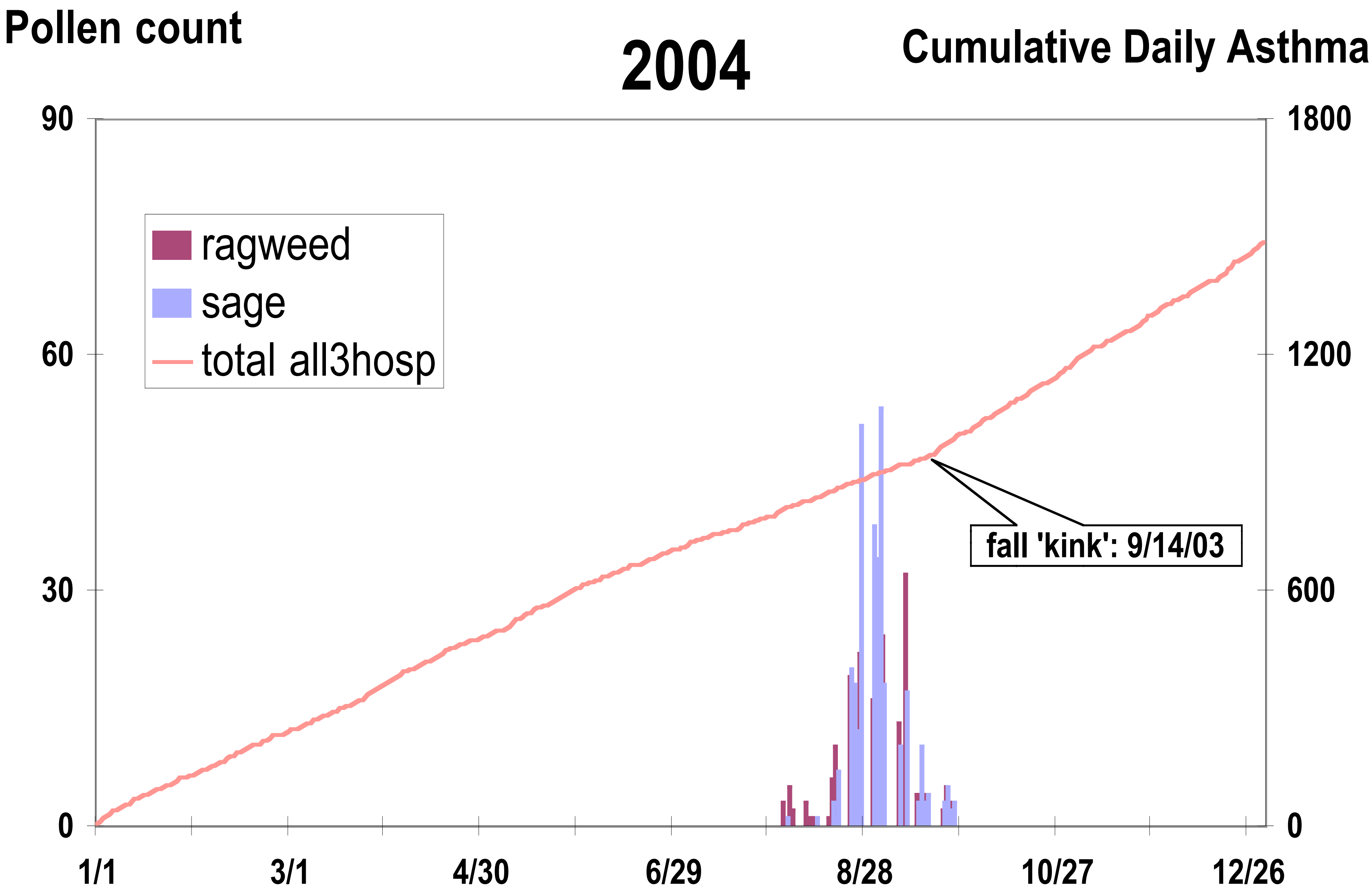
New England Integrated Sciences & Assessment

Seacoast Hospital Asthma Admissions vs. Salem Pollen



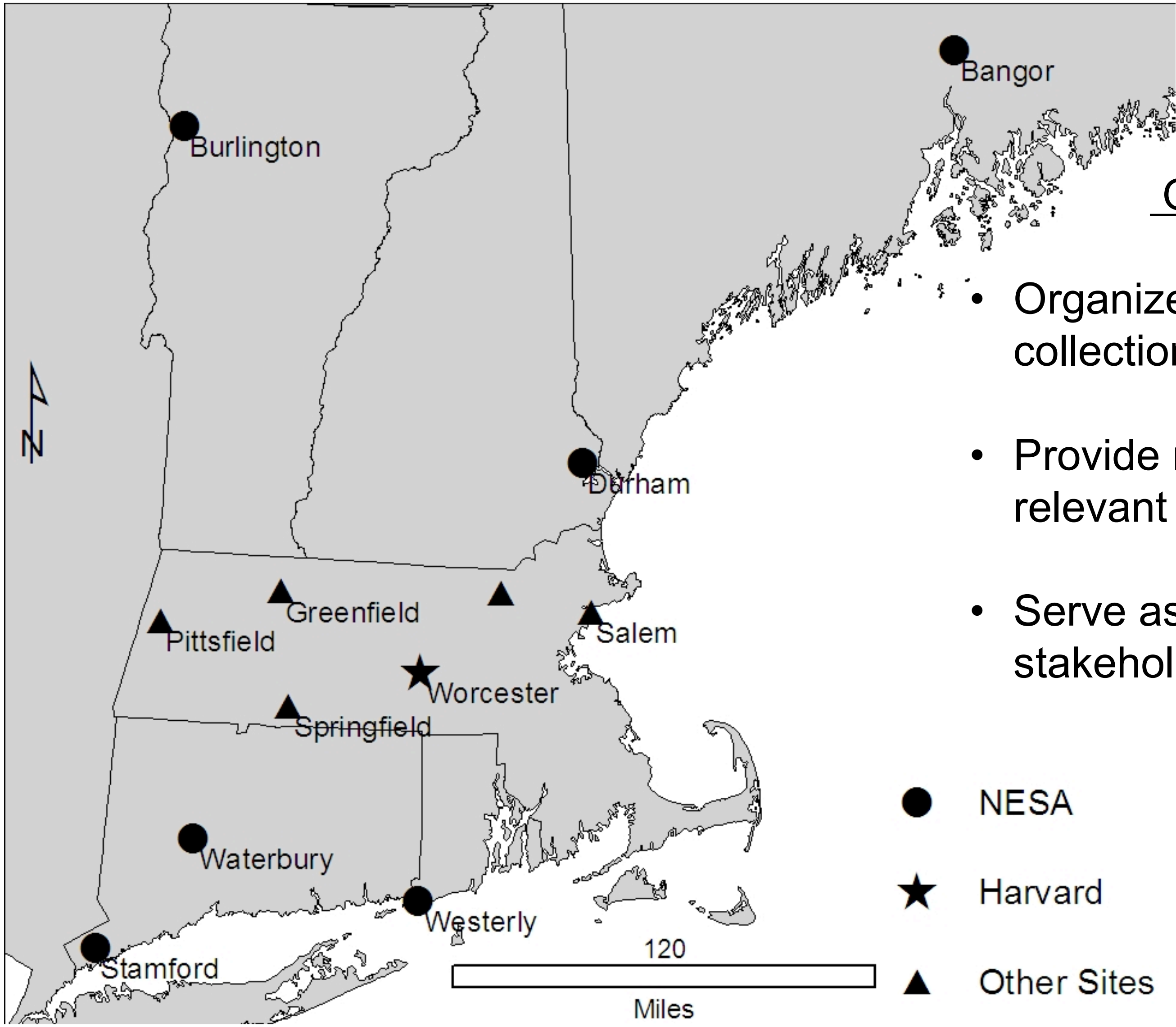
New England Integrated Sciences & Assessment

Seacoast Hospital Asthma Admissions vs. Salem Pollen



New England Integrated Sciences & Assessment

New England Pollen Collection Sites - 2005



Objectives

- Organize pollen and mold data collection and QA/QC
- Provide near real-time decision relevant allergen information
- Serve as data archive for stakeholders and researchers

New England Integrated Sciences & Assessment

2.2 AIRMAP Streaming Real Time Air Quality Data Dimond Library, UNH

New England Integrated Sciences & Assessment

neisa.unh.edu

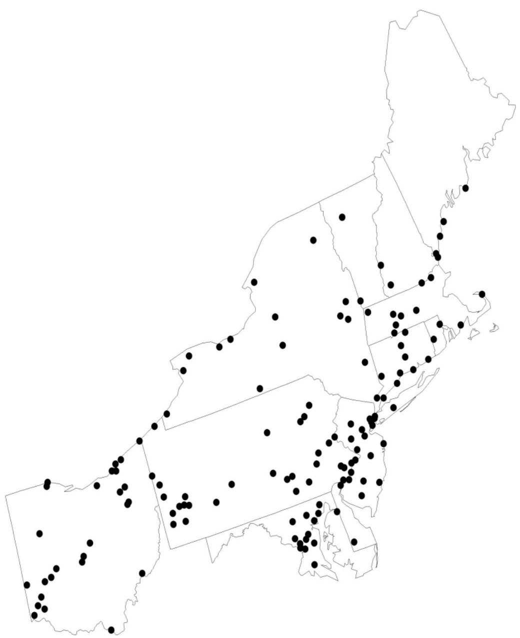
2.3 Interannual climate-ozone linkages in the Northeast

- Why ozone?
  - Many stations with long records
  - Builds on previous analyses
  - Potentially useful as “springboard” to examine other pollutants

- Daily (normalized) 8-hr ozone maxima
- April 1 – October 31; 1980-2004

- Daily (normalized) 8-hr ozone maxima (EPA)
- April 1 – October 31; 1980-2004

315 total ozone stations

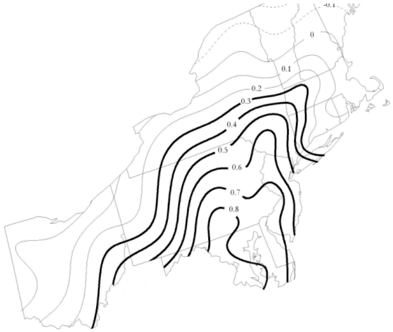


146 stations with 15+ yrs

De-clustered to 58 final

New England Integrated Sciences & Assessment

PCA Component Maps

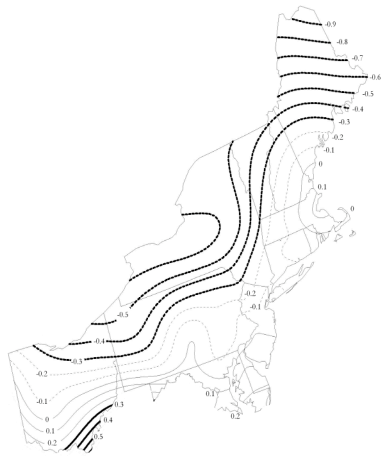


PC 1 (59.9%)
"Mid-Atlantic"

PC 2 (9.6%)
"Ohio"

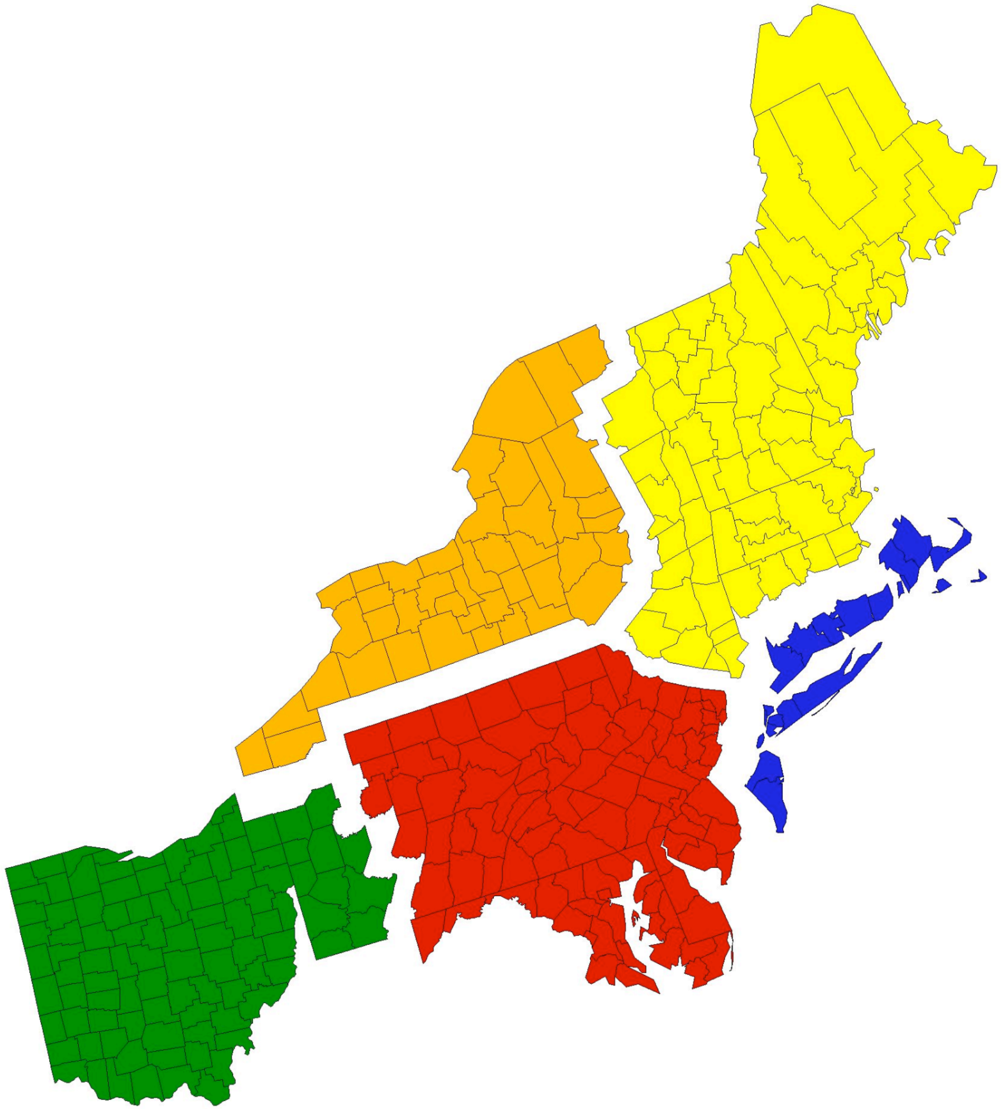
PC 3 (7.4%)
"New England"

PC 4 (3.2%)
"South Coast"



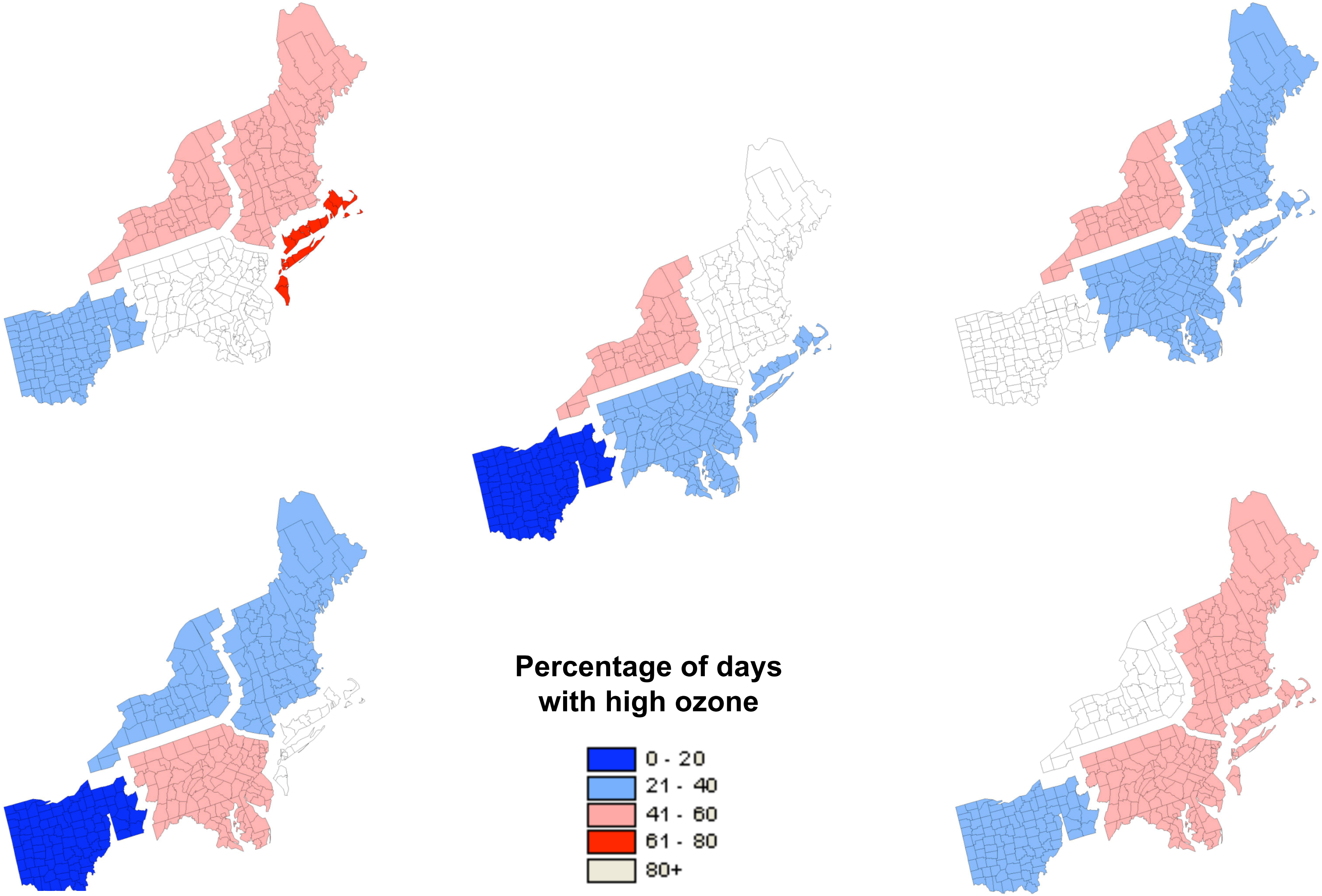
PC 5 (2.1%)
"Northern NY"

Ozone Regions



New England
Integrated Sciences & Assessment

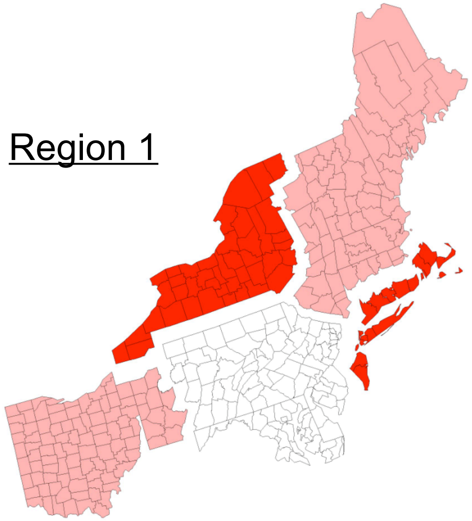
High Ozone Days



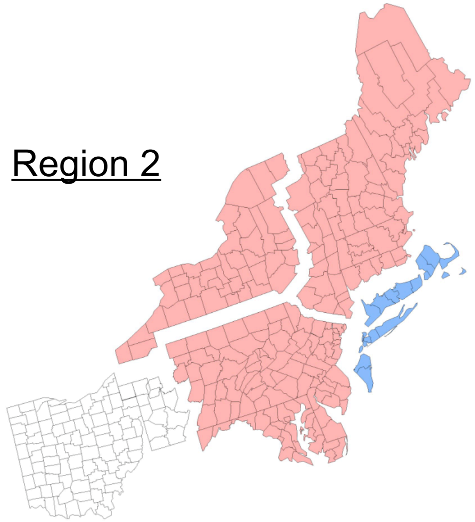
New England
Integrated Sciences & Assessment

Multi-Day High Ozone Events

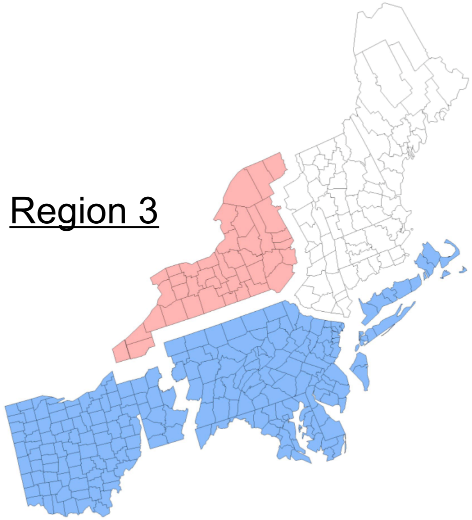
Region 1



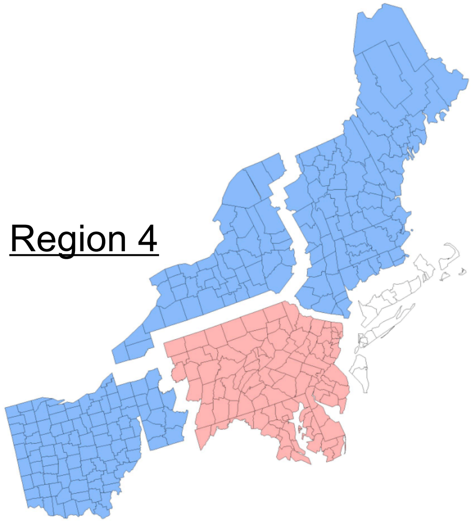
Region 2



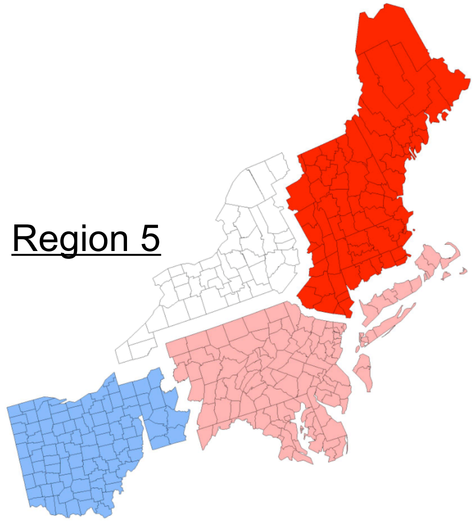
Region 3



Region 4



Region 5



Percentage of days with high ozone

0 - 20
21 - 40
41 - 60
61 - 80
80+

New England Integrated Sciences & Assessment

Status and Next Steps

- Currently finishing manuscript focusing on PCA regionalization & circulation anomalies
- Examine temporal variability of ozone events within each region
  - Indexing analysis (MJO, NAO, ENSO, etc.)
- Examine circulation anomalies for both high- and low-ozone events
- Apply this “model” to other measures of air quality

2.4 The Illness Cost of Air Pollution (ICAP) Model

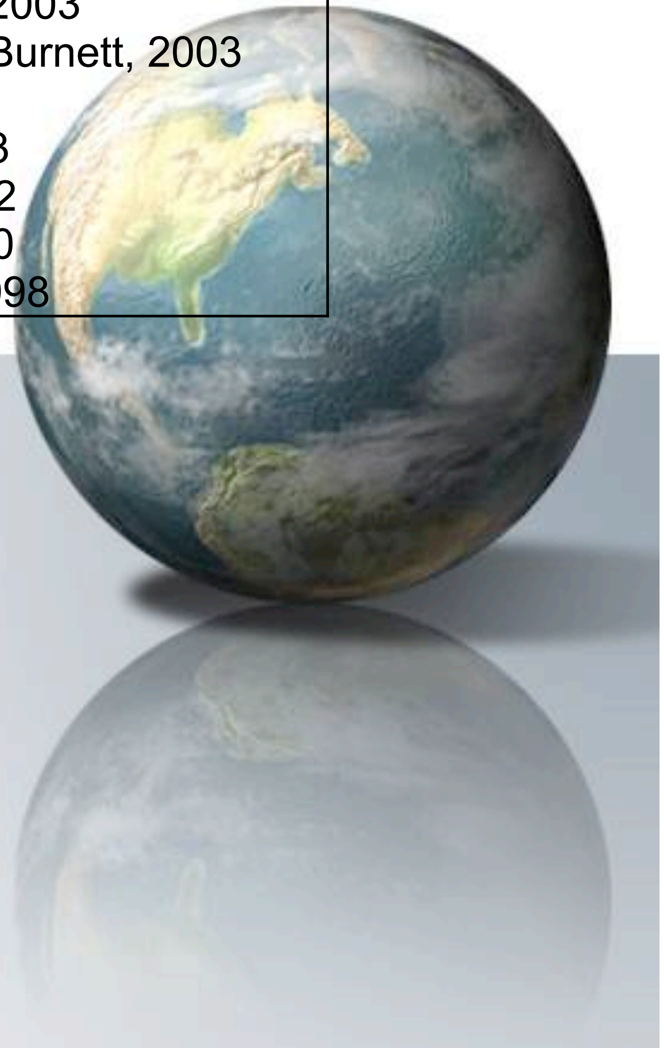
- Originally developed for the Ontario Medical Association (OMA)
- Relevant OMA Objectives
  - Produce reasonable quantitative health damage forecasts
  - Support its advocacy for improvements in air quality
- Used by
  - Local medical officers of health and doctors
  - Private citizens and community groups
  - Educators
  - Policy analysts
- New England Version (Maine and NH)
  - Currently being finalized
  - Developed in collaboration with ALA of Maine
  - Provides results by county
  - Daily to annual resolution

Sources for Concentration-Response Functions

	PM2.5	Ozone
Premature Death		
Total	2,8	4
Respiratory	6	6
Cardivascular	5	6
Cardio-respiratory	8	4
Lung cancer	8	
Hospital Admissions Respiratory		
Total	1	1
Asthma	3	3
COPD	3	3
Pneumonia	3	3
Hospital Admissions Respiratory		
Total	1	1
CAD	3	
Dysrthymia	3	1
CHF	3,6	
Emergency Room Visits		
Respiratory	9	7
Cardovascular	9	
Minor Illness	10	

Reference Codes:

1 - Burnett et al, 1997
2 - Burnett and Goldberg, 2003
3 - Burnett et al, 1999
4 - Dominici et al, 2003
5 – Goldberg and Burnett, 2003
6 - Ito, 2003
7 - Jaffe et al, 2003
8 - Pope et al 2002
9 - Stieb et al, 2000
10 - Vedal et al, 1998



New England
Integrated Sciences & Assessment

Illustrative ICAP Application

Compare adverse health and economic predictions for 3 ozone scenarios for Maine:

- – 15 days in July
- – Baseline (40 ppb)
- – Standard (2000-2002 Measured)
- – 15 High Ozone Days (100 ppb)

ICAP Predicted Premature Mortalities & Hospital Admissions (15 Days in July in Maine)

Age Groups	Baseline O3 (40 ppb)	Standard Ozone	High O3 (100ppb)
ICAP Predicted Premature Mortalities			
0-17	0	0	0
18-65	0.2	0.4	0.6
65+	1.1	1.8	2.8
ICAP Predicted Hospital Respiratory Admissions			
0-17	9.3	14.5	20.7
18-65	15.5	24.5	34.5
65+	10.7	16.7	23.8
ICAP Predicted Hospital Cardiovascular Admissions			
0-17	0.2	0.3	0.4
18-65	34.4	53.9	75.2
65+	41.3	64.3	90.4

ICAP Predicted Economic Costs
(15 Days in July in Maine)

	Baseline O3 (40 ppb)	Standard Ozone	High O3 (100ppb)
Pain and Suffering	$152,232	$239,543	$339,396
Premature Mortality	$1,116,845	$1,846,816	$2,777,118
Health Care Costs	$357,021	$558,998	$787,599
Lost Productivity	$57,066	$89,770	$126,504

Health Care Costs From Transport of PM2.5 & Ozone into NH

Health Impact Category	Estimated N.H. Incidences (Projected for 2007)	Monetary Value per Incidence (Abt Associates, 1999$)	N.H. Estimated Annual Health Valuations for 2007 (1999$)
Premature deaths (Mortality)	123	$6,120,000	$753,470,000
Chronic bronchitis cases	82	$331,000	$27,110,000
Acute bronchitis	228	$57	$13,000
Hospital admissions	87	$14,811	$1,290,000
Emergency room asthma visits	31	$298	$9,000
Asthma attacks	1,947	$40	$106,000
Upper Respiratory Symptoms - URS	1,923	$23	$61,000
Lower Respiratory Symptoms – LRS	1,800	$15	$36,000
Work days lost	17,146	$105	$2,410,000
Minor restricted activity days	117,150	$48	$5,670,000
State Total			**$790,170,000**

Health related costs from transport of ozone into NH: $234,970,000

TOTAL: $1,025,140,000

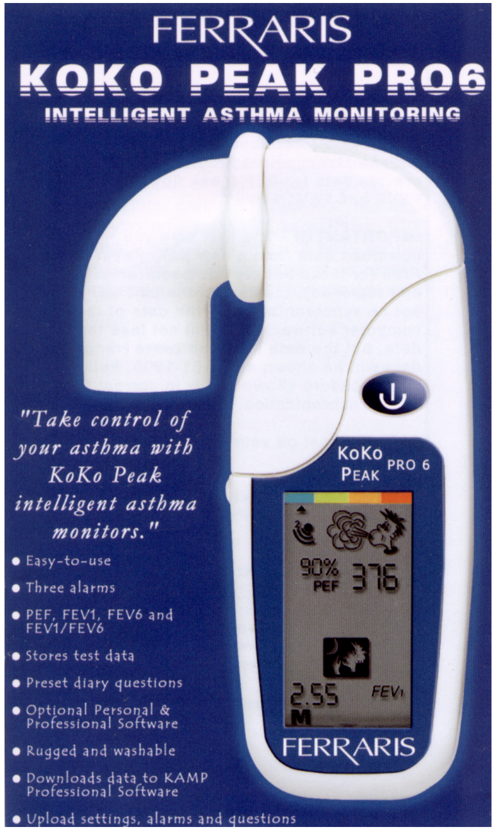
NH DES, 2004, Air Pollution Transport and How it Affects New Hampshire
http://www.des.state.nh.us/ard_intro.htm

2.5 Summer 2004 New England Health Tracking: Part of ICARTT

International Consortium for Atmospheric Research on Transport and Transformations

INHALE - Summer 2004 Pulmonary Function Monitoring

Spirometry
Twice daily



Respiratory Symptoms
Once daily

In the last 24 hours have you experienced any of the following?

Coughing	☐ Yes	No ☐
Wheezing	☐ Yes	No ☐
Shortness of breath	☐ Yes	No ☐
Chest tightness	☐ Yes	No ☐

Within the past 24 hours have you taken any medications? ☐ Yes No ☐

If yes:
Medication name? ____________
When did you take it? ____________
How much did you take? ____________

Did you have to limit any of your activities in the past 24 hours? ☐ Yes No ☐

Did you remain within 10 miles of your home area today? ☐ Yes No ☐

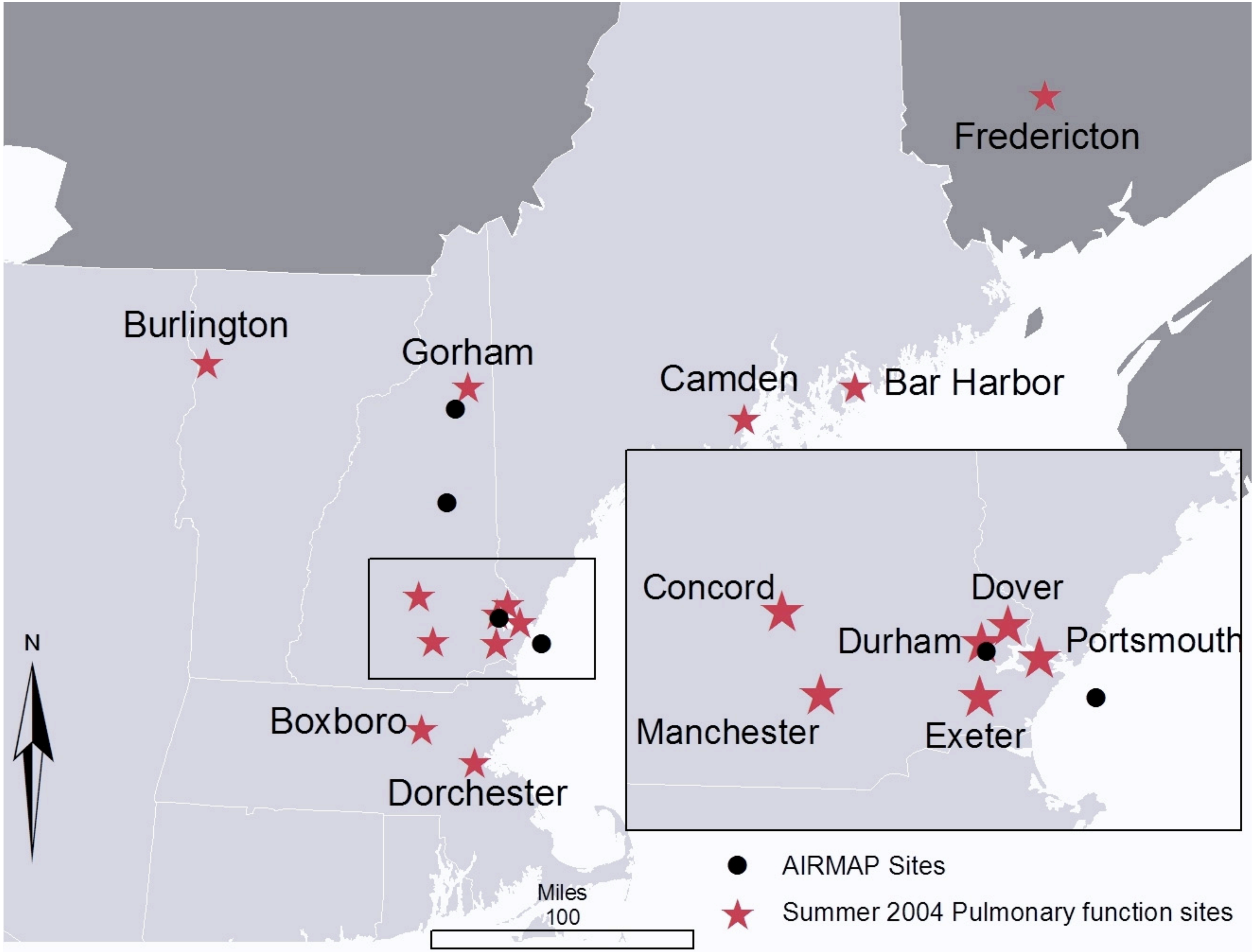
Within 100 miles? ☐ Yes No ☐

Day 1 | **No change in condition from yesterday** ☐

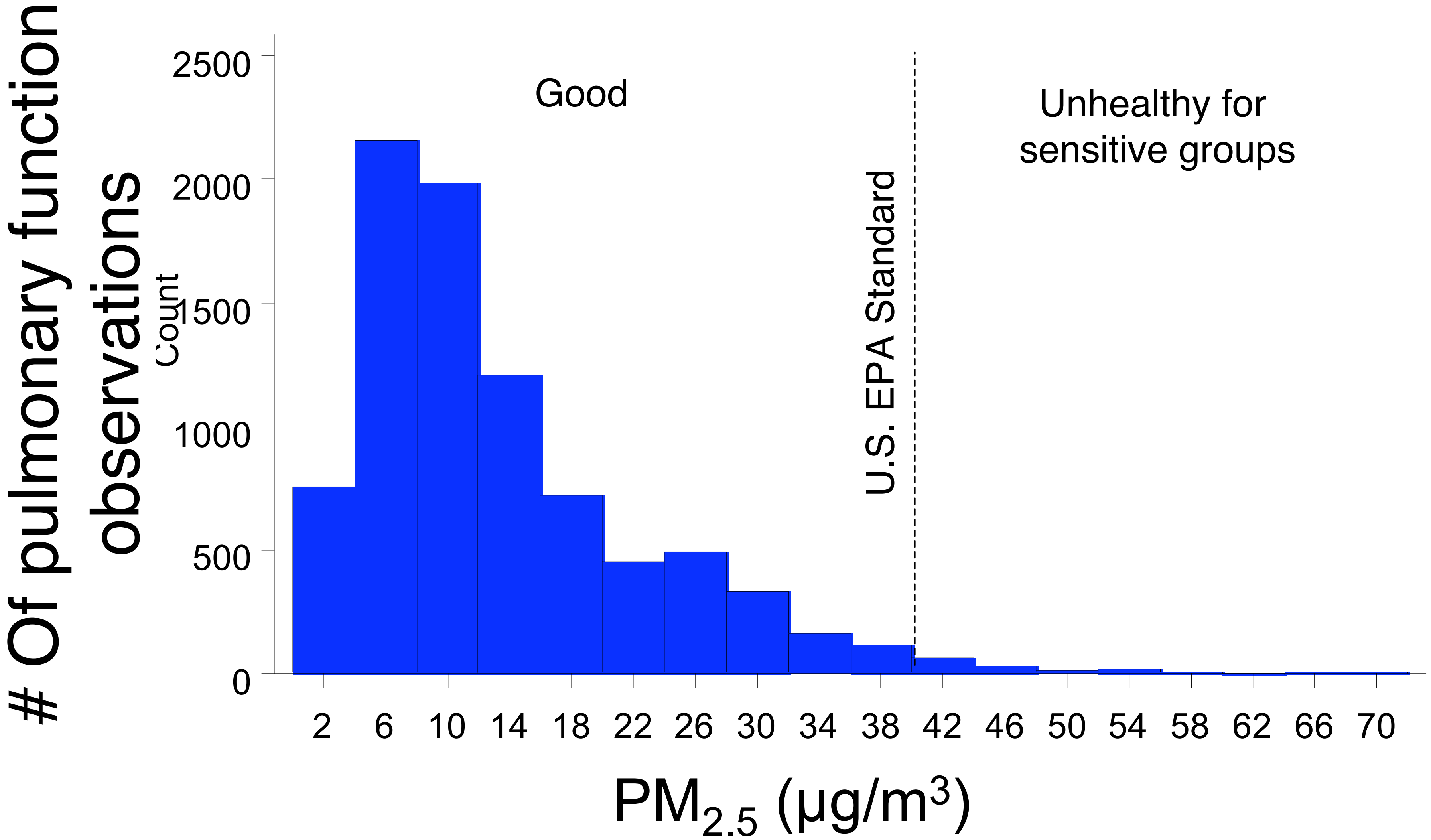
Please add any additional information on the back

New England Integrated Sciences & Assessment

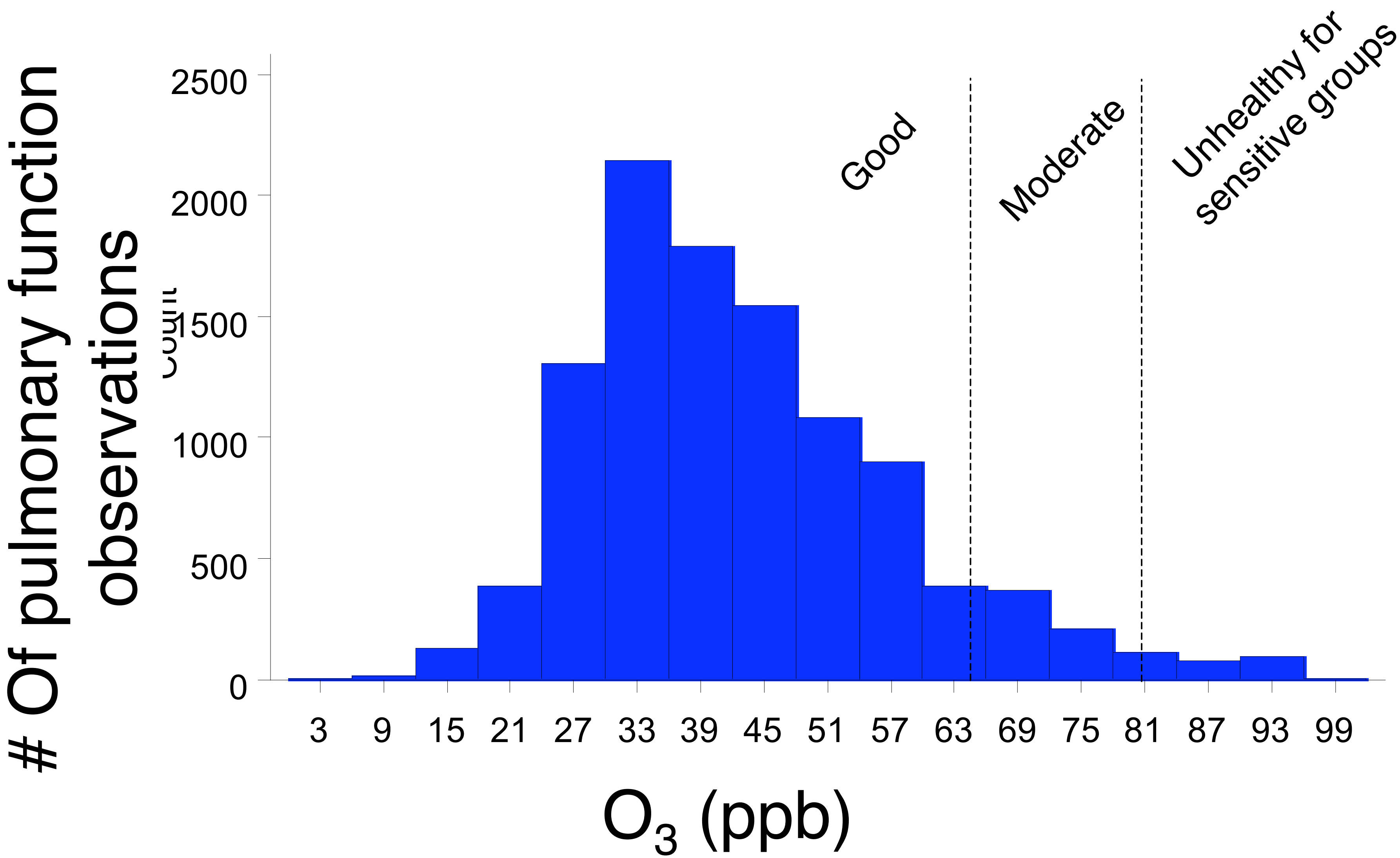
Summer 2004 New England Health Tracking Campaign



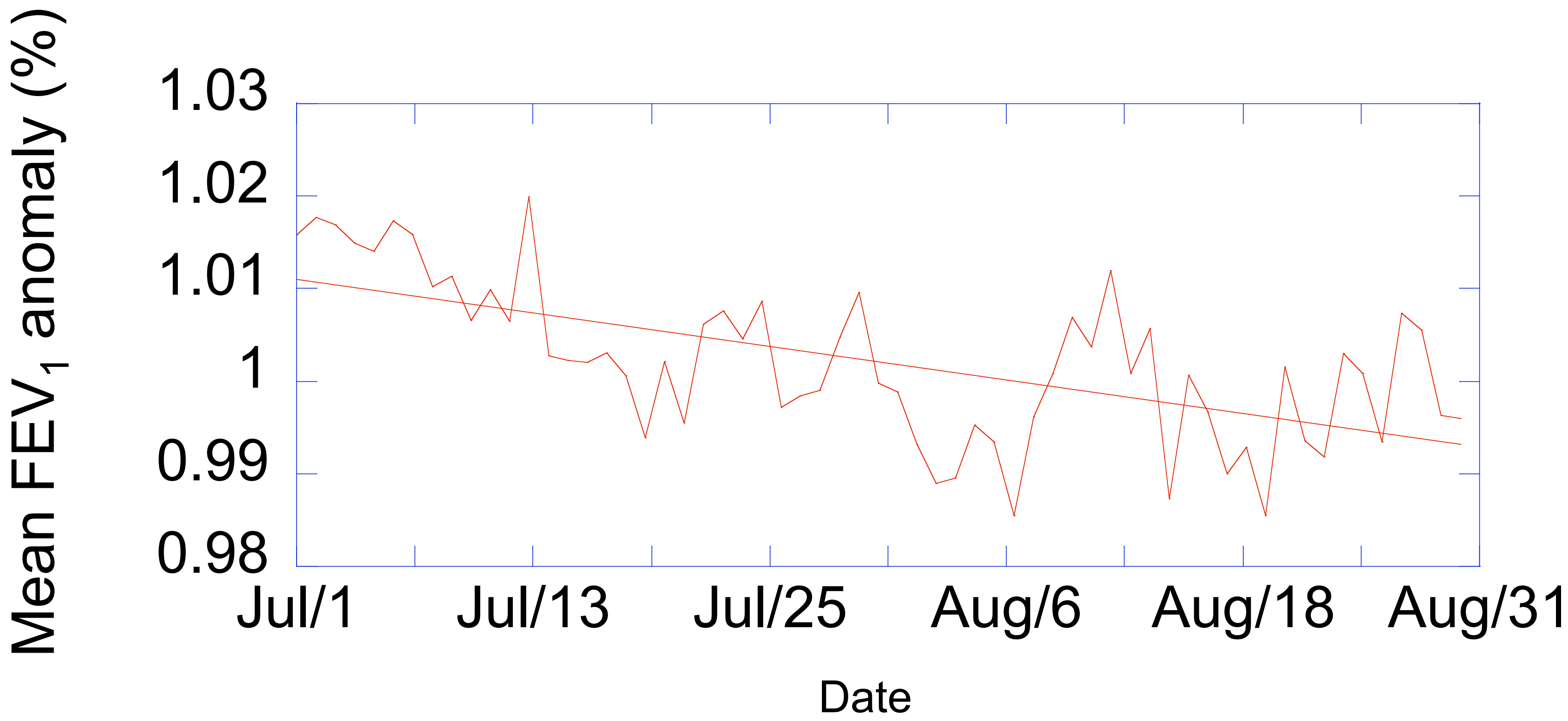
Previous 24 hour mean $PM_{2.5}$ exposures

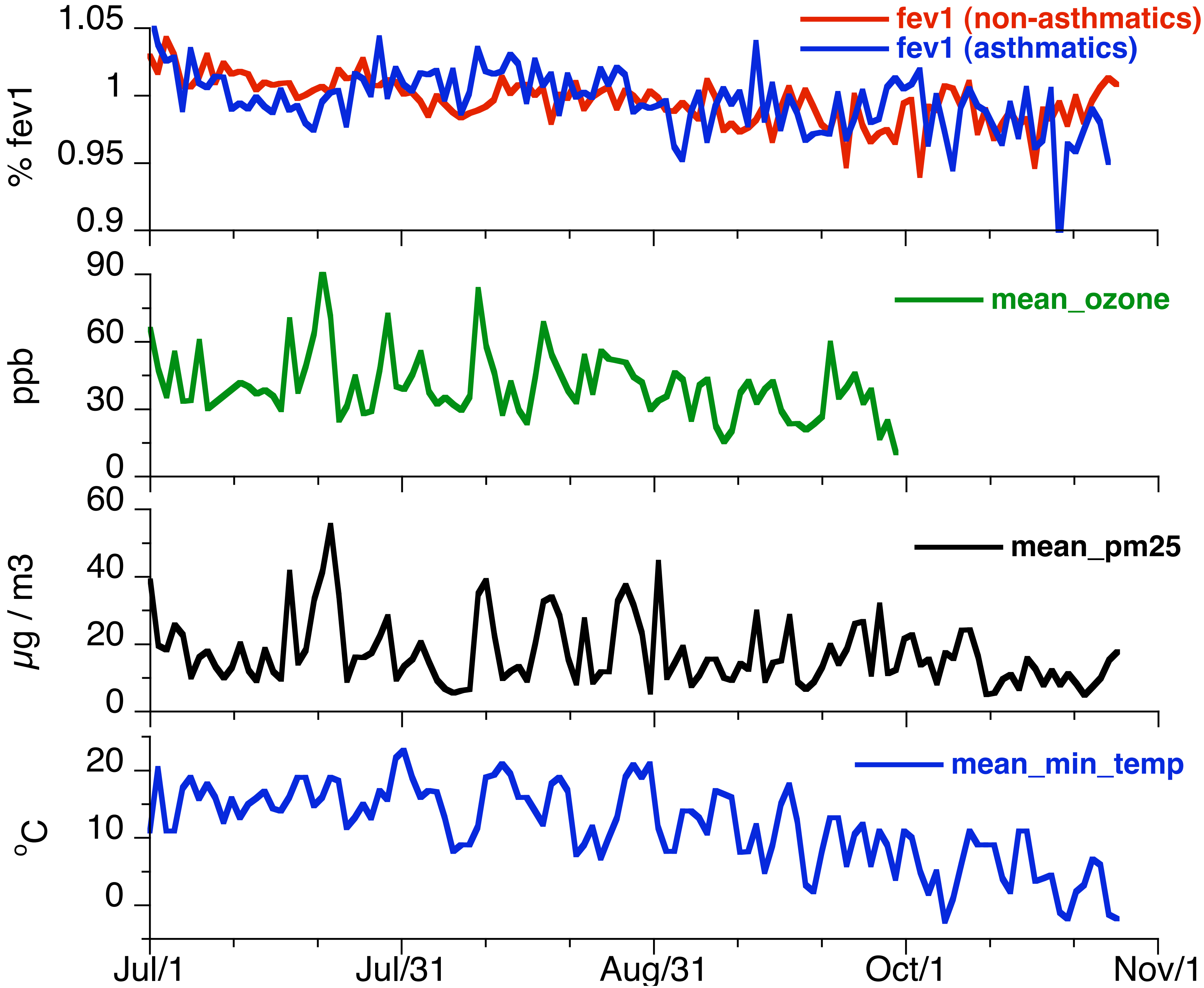


Maximum 8-hr ozone during previous 24-hr



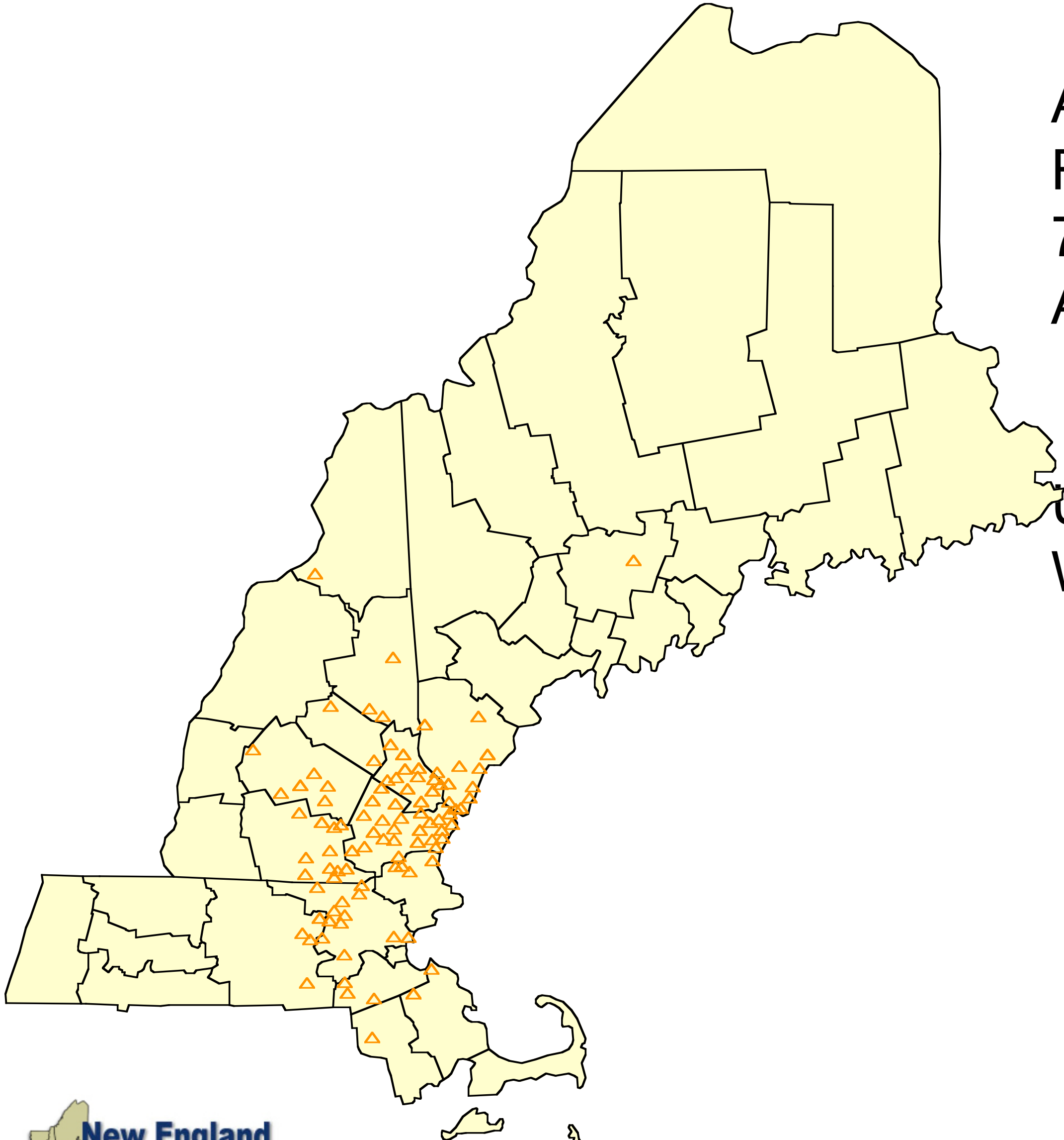
Pulmonary function decline over course of summer





fev1 (non-asthmatics)
fev1 (asthmatics)
% fev1
1.05
1
0.95
0.9
mean_ozone
ppb
90
60
30
0
mean_pm25
μg / m3
60
40
20
0
mean_min_temp
°C
20
10
0
Jul/1
Jul/31
Aug/31
Oct/1
Nov/1

Air Quality and Indoor Worker Productivity Summer 2004 Volunteer Employee Survey



Average Number of Respondents: 321

70% Women; 30% Men

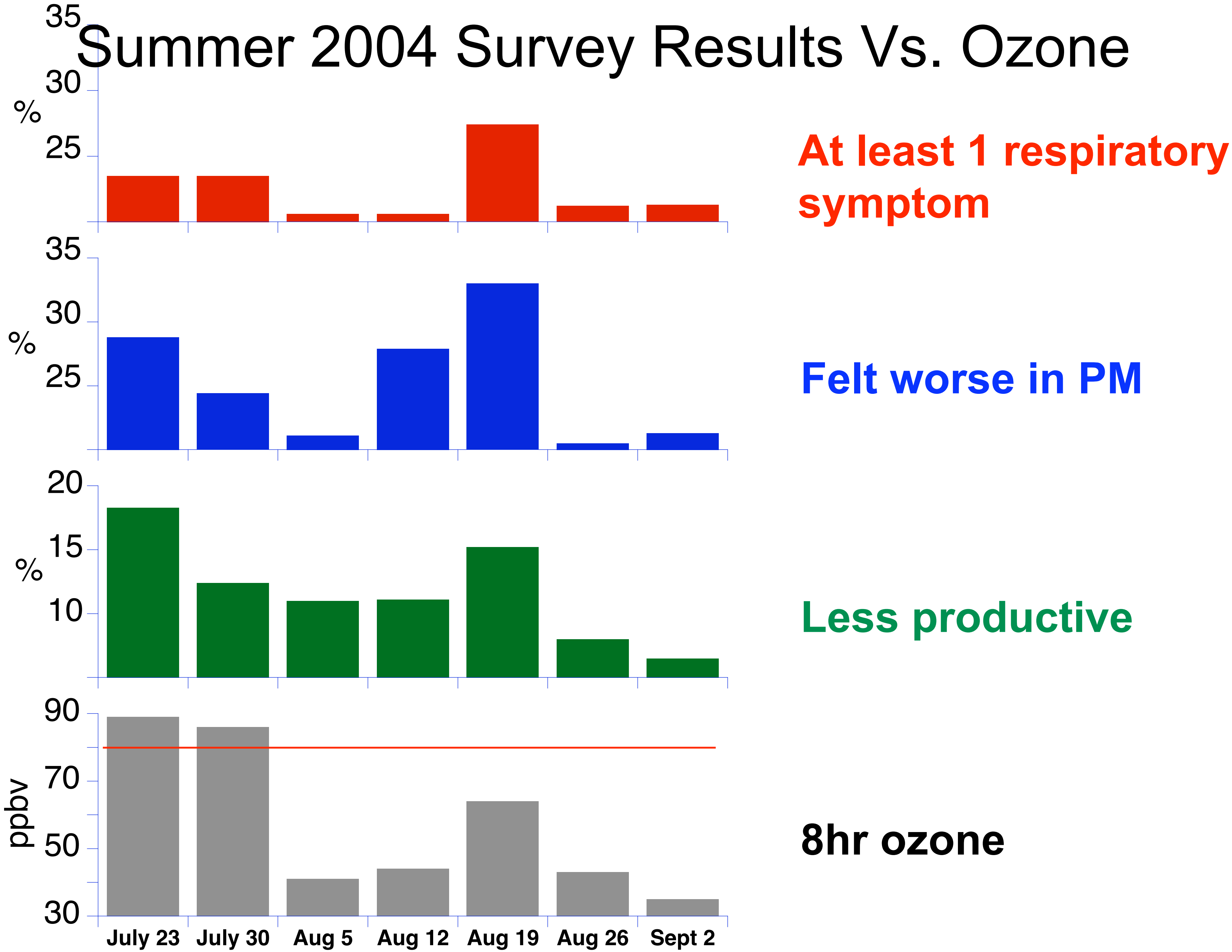
Average Age: 42- 43

50% of respondents between 33-50

UNH, Cisco Systems Exeter, W-D and Portsmouth Hospitals

New England Integrated Sciences & Assessment

Summer 2004 Survey Results Vs. Ozone



3. Next Steps

- Detailing interannual variability and decadal trends in climate, atmospheric chemistry, and pollen
- Improved messaging regarding daily air chemistry forecasts provided by EPA and NOAA.
- Forecast for the timing and magnitude of the fall rise in hospital admissions
- Further development and dissemination of illness cost of air pollution (by day, week, month year, and in the future) for every county in New England
- Targeted forecasts of opportunity such as winter snowfall, winter storm or spring water quality and quantity


Advertising Justin Novak